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CONTENTS AND INDEX.

N. S. VOL. V—JANUARY TO JUNE, 1897.

The Names of Contributors are Printed in Small Capitals.

Acquired Characteristics, The Inheritance of, E. D. COPE, 633; JOHN M. MACFARLANE, 935
Adams, F. D., and A. E. Barbour, Laurentian Highlands of Canada, 96, 406, 578
Adaptation in Pathological Processes, WILLIAM H. WELCH, 813
ADLER, CYRUS, Goode Memorial Meeting, 365
Agassiz, Louis, WILLIAM JAMES, 285
Agriculture, Department of, Inadequacy of Salaries, 223; A Director of Scientific Work for the, 267; Report of the Secretary of, 272
Alabama Industrial and Scientific Society, EUGENE A. SMITH, 72, 926
Aldrich, T. B., Mephitis Mephitica, 911
Allen, E. W,, Fleischman on Milchwirtschaft, 557
ALLEN, HARRISON, Glossophaga Truei, 153; The Effects of Disease and Senility as illustrated in the Bones and Teeth of Mammals, 289
ALLEN, J. A., The Discrimination of Species and Sub-species, 877
Allen, J. A.. New Species of Mountain Sheep, 618
Allen, T. F., New Species of Nitella, 36
Alloy of Aluminum and Zinc, 396
Ambrosetti on the Monoliths of Tafi, 724
American, Journal of Science, 33, 228, 406, 589, 738, 888, 998; Association for the Advancement of Science, 398, 652, 965; F. W. PUTNAM, 760; Academy of Arts and Sciences, 801
Ames, Joseph S., Spectrum Analysis, 319
Anatomie microscopique, Archives d', 183
Andrée, S. A., Carbon Dioxid in the Atmosphere, 798
Andreoli, E., Ozone, 798.
Angot's Aurora Borealis, 649
Annuaire du Bureau des Longitudes, 181
Anthony and Brackett, Physics, 805
Anthropological Society of Washington, J. H. MCCORMICK, 35, 194, 487, 594, 856, 927
Anthropology, Current Notes on, D. G. BRINTON, 22, 53, 100, 141, 178, 220, 265, 302. 339, 393, 438, 469, 509, 545, 578, 614, 650, 688, 724, 797, 835, 871, 913, 947, 988, and Psychology, N. Y. Academy of Sciences, LIVINGSTON FARRAND, 283, 776
Antony, U., and T. Benelli, Action of Water on Lead Pipes, 546, and A Lucchesi, Mercurous Chlorid and Auric Chlorid, 546
Apprenticeship Question, R. H. THURSTON, 299
Archæological, Report of Ontario, 393; Discoveries made in the Gravels at Trenton, G. FREDERICK WRIGHT, D. G. BRINTON, 586.
AREY, ALBERT L., The Educational Value of the Physical Sciences, 460
Argentaurum Papers, C. A. YOUNG, 343
Argon in inhaled and exhaled Air, 949
Armstrong, H. E., Osmotic Pressure, 101; Organizing Scientific Opinion, 549
Arsenic Poisoning from Fabrics, 949
Ashmead, Belenocnema treatæ, Mayer, 237; Canarsia hammondi, 559; Roptronia, 560
Astronomical, Journal, 23; Notes, H. J., 102, 180, 222, 303; Medal, The Bruce, EDWARD S. HOLDEN, 620; Association, British, 803
Astronomy, Problems of, SIMON NEWCOMB, 777; Beginnings of American, EDWARD S. HOLDEN, 929; and Physics, N. Y. Academy of Sciences, W. HALLOCK, 70, 359, 452
Astrophysical, Notes, E. B. F., 726, 764, 836; Journal, 521, 591, 628
ATKINSON, GEO. F., Die Bedingungen der Fortpflanzung bei einigen Algen und Pilzen, George Klebs, 353; Analytic Keys to North American Mosses, C. R. Barnes, 519; Diseases of Plants induced by Cryptogamic Parasites, Karl. v. Tubeuf, 696
Atoll of Funafuti, 343
Auk, The, 281, 739
Australasian Association for the Advancement of Science, 801
Axe, The Grooved Stone, 914
Ayres, Howard, Brain Cells of the Adult Body, 358

B., H. F., Journal of Geology, 190, 282, 519, 701, 925
Bailey, L. H., The Survival of the Unlike, CHARLES E. BESSEY, 109; 514
BAIN, H. F., Geological Bibliographies, 556; Clay Deposits of Miss., H. A. Wheeler, 852
BAKER, FRANK, Vertebrated Animals in the Zoological Gardens of London, 404
BAKER, FRANK C. and FRANK M. WOODRUFF, Note on Natrix Grohamii, B. & G., 447
Balch, E. S., On Ice Caves, 870
BALDWIN, J. MARK, Die Spiele der Thiere, Karl Groos, 347; Organic Selection, 634
Ball, W. W. Rouse, History of Mathematics, E. M. BLAKE, 352
Balmer, J. J., Wave-lengths of Spectral Lines, 628
Baltzer, A., The Diluvial Aar Glacier, 508
Bancroft, F. W., Chelyosoma productum, Stimson, 435
BANCROFT, WILDER, D., Traité élémentaire de mécanique chimique, P. Duhem, 625
Barbour, E. H., Dæmonelix, 94
Barnes, C. R., Analytic Key to the Genera and Species of North American Mosses, GEO. F. ATKINSON, 519
BARROWS, FRANKLIN W., The N. Y. State Science Teachers' Association, 457, 498, 531

Barter, C., Notes on Ashanti, 264
Bartlett, E. J., and W. F. Rice, Silver Hydride, 157
BARTON, G. H., Lieut. Peary's Expedition, 308
Barton, George H., Glacial Observations in the Umanak District, Greenland, 89
BARUS, C., The Blackboard Treatment of Physical Vectors, 171
Barus, C., An Interferential Induction Balance, 229; Diaphragm of a Telephone made with Special Interference Apparatus, 407; The Idiostatic Electrometer, 485
Bascom, Florence, Pre-Cambrian Volcanics of the South Mountain District, 95; The Schuylkill, 177; Streams in Neighborhood of Philadelphia and the Bryn Mawr Gravel, 230
BATCHELDER, C. F., Papers presented to the World's Congress on Ornithology, Irene E. Rood, 189
BATHER, F. A., How May Museums best Retard the Advance of Science? 671; The Re-distribution of Type-specimens in Museums, 694; A Postscript to the Terminology of Types, 843
Bather, F. A., Museums and Science, F. A. LUCAS, 543
Bats, Migration of, on Cape Cod, Mass., GERRIT S. MILLER, JR., 541
Bauer, L. A., Distribution and the Secular Variation of Terrestrial Magnetism, 192; Vertical Earth-Air Electric Currents, 665
Baumann, Professor Eugen, LAFAYETTE B. MENDEL, 51
BAUR, G., Pareisauria Seeley (Cotylosauria Cope) from the Triassic of Germany, 720; Distribution of Marine Mammals, 956
Baur, G., and E. C. Case, The Pelycosauria, 592
Beal, W. J., Grasses of North America, F. LAMSON SCRIBNER, 62
BEARD, J., Problems of Vertebrate Embryology, 107
Becker, George F., Rock Magmas, 33
Beecher, C. E., Natural Classification of Trilobites, 228; Geological and Natural History Survey of Minnesota, N. H. Winchell, 449
Behrens, H., Mikrochemischen Analyse, E. R., 115
Bell, Robert, Canadian Rivers, 946
BEMAN and SMITH, Compliment or Plagiarism, 61, 275, 478
Bendire, Charles E., C. HART MERRIAM, 261; 304; Earliest Published Note of, C. H. M., 805
Benton, Frank, The Giant Bee of India, 319
BERKEY, CHARLES P., Geological Club of the University of Minnesota, 196, 363, 487
Berthelot, Chemical Analyses of Weapons, 545
BESSEY, CHARLES E., The Survival of the Unlike, L. H. Bailey, 109
Bibliographia Physiologica, 105
Bibliographies, Geological, H. F. BAIN, 556
Biedermann, W., Electro-Physiology, HENRY SEWALL, 481
Biological, Society of Washington, F. A, LUCAS, 159, 236, 319, 487, 629, 688, 739, 810, 963; Survey of Alabama, 144; Station, at Puffin Island, 840; on the Black Sea, 989
Biology, N. Y. Academy of Sciences, C. L. BRISTOL, 71, 319; BASHFORD DEAN, 595
Bird, Protection, Report of the Committee on, 282; Pictures, Professor Scott's, F. A. LUCAS, 620
Birds, Color Change in the Plumage of, unaccompanied by Moult, F. A. L., 762
BLAKE, E. M., History of Mathematics, W. W. R. Ball, 352; Florian Cajori, 352
Bloch on the Red Race of Madagascar, 266
Blythe, Winter, Formaldehyde, 948
BOAS, FRANZ, The Growth of Children, 570
Boas, Franz, Star Legend of Alaska, 216
Bolton, Herbert, Lancashire Coal Field, 560
BOLTON, H. CARRINGTON, Two Extraordinary British Patents, 401
Bolton, H. Carrington, Man's Speech to Brutes, 835; Early Chemical Societies, 855
Bolyai, John, Non-Euclidean Geometry, A. S. HATHAWAY, 311
Bones and Teeth of Mammals, The Effects of Disease and Senility as illustrated in the, HARRISON ALLEN, 289
Boston Society of Natural History, SAMUEL HENSHAW, 34, 72, 196, 361, 632, 703, 891, 964
Botanical, Gazette, Evolution of the, 24; Society, Royal, 270; Laboratory, A New, in the American Tropics, D. T. MACDOUGAL, 395; Garden, The Missouri, 610; Society of London, 693; Society of America, 838
BOWDITCH, H. P., Opportunities for Training in Physiology, 446
Bowditch, H. P., The Relation between Height, Weight and Age, in Young Children, 131; Movements of the Alimentary Canal, 901
Brabrook, E. W., Ancient Man in England, 302; on the Progress of Anthropology, 578
Bradley, W. P., and F. Kniffen, Paraisobutylphenoxyacetic Acid, 157
Brain, Primary Segmentation of the, C. F. W. MCCLURE, 260
BRANNER, JOHN C., New Terms in Geology, 912
Branner, John C., Beauxite Deposits of Ark., 702
BRINTON, D. G., Current Notes on Anthropology, 22, 53, 100, 141, 178, 220, 265, 302, 339, 393, 438, 469, 509, 545, 578, 614, 650, 688, 724, 797, 835, 871, 913, 947, 988; Les Aryens au Nord et au Sud de l'Hindou-Kouch, Charles de Ujfalvy, 68; Prehistoric Man and Beast, H. N. Hutchinson, 154; Horatio Hale, 216; Codice Messicano Vaticano, 355; L'evolution de l'esclavage, Ch. Letourneau, 448; Researches on the Antiquity of Man in the Delaware Valley and the Eastern United States, Henry C. Mercer, 484; Biologia Centrali-Americana: Archæology, J. T. Goodman, 662; Anthropologia della Stirpe Camitica, G. Sergi, 808; The Potter's Wheel in America, 958; The Swastika, Thomas Wilson, 960; L'Origine de la Nation Française, Gabriel de Mortillet, 961
Brinton, D. G., Psychic Origin of Myth, 216
BRISTOL, C. L., Biology, N. Y. Academy of Sciences, 71, 319
British Association for the Advancement of Science, 223, 580, 767, 915; A. B. MACALLUM, 251
Britton, E. G., Mexican Ferns, 631
BRITTON, N. L., Torrey Botanical Club, 925
Brown, E. W., The Lunar Theory, 100
Brown, Stimson J., The Companion of Sirius, 102
Bruner, Lawrence, Injurious Locusts, 691
Bumpus, H. C., Suspension of Natural Selection and the introduced English Sparrow, 423
Burckhardt, Carl, Limestone Range of the Klonthal, Switzerland, 797
BURGESS EDWARD S., Torrey Botanical Club, 284, 451, 523, 595, 631, 891

Burton, A. E.. on the Umanak District, 34
Buschan on Stature and Weight, 469
Buys-Ballot, Monument, A. LAWRENCE ROTCH, 994
Byrnes, E. F., The Eggs of Limax, 391

CAJORI, FLORIAN, History of Elementary Mathematics, 516
Cajori, Florian, History of Elementary Mathematics, E. M. BLAKE, 352
California Academy of Sciences, 583
Calvin, S.. Slate Quarry Limestone, 317
Cameron, F. K., Isomorphism and Crystal Structure in Organic Compounds, 774
Campbell, Marius R., Erosion at Baselevel, 83; Origin of Certain Topographic Forms, 83; Drainage Modifications, 437; and W. C. Mendenhall, Plateau of West Virginia, 947
Candlot, E., Cements and Sea Water, 799
Carbide of Calcium, 545
Carleton, M. A., Stem Rust on Wheat and Oats, 237; Climate in Wheat Environment, 810
Case, E. C., Cranial Region of Dimetrodon, 594
Cattell, J. McKeen, Researches in Progress in the Psychological Laboratory of Columbia University, 209; An Ergometer, 909
Cavins, Frederick A., Quantitative Chemical Analsis, W. A. N., 281
Ceramics, American, 797
Chadbourne, A. P., Individual Dichromatism, 281; and Frank M. Chapman, Spring Plumage of the Bobolink, 739
Chalmot, G. de, Silicide of Chromium, 157; Silicides of Copper and Iron, 357
CHAMBERLIN, T. C., Former Extension of Greenland Glaciers, 400; Former Extension of Cornell Glacier near the Southern End of Melville Bay, 748; Former Extension of Ice in Greenland, 515
Chamberlin, T. C., Glacial Studies, 701
Chandler, S. C., The Variation of Latitude, 758
Chapman, Frank M., Bird Life, HARRY C. OBERHOLSER. 997
Chatelain, Heli, African Life Illustrated, 216
Chemical, Journal, American, J. ELLIOTT GILPIN, 157, 356, 520, 664, 852, 961; Society. N. Y. Section, DURAND WOODMAN, 71, 239, 360, 487, 740; of Washington, A. C. PEALE, 115; V. K. CHESNUT, 196, 557, 774, 855
Chemistry, Inorganic, Notes on, J. L. H., 101, 179, 221, 266, 394, 439, 470, 545, 615, 651, 725, 783, 798, 872, 914, 948; in the United States, F.W. CLARKE, 117; Inorganic and Organic, 763
CHESNUT, V. K., Chemical Society of Washington, 196, 557, 774, 855
Chesnut, V. K., Water Hemlock and Laurier Rose, 237; Poison of the Black Nightshade, 964
Chessin, Alexander S., The Motion of a Physical Pendulum, 100
CHILD, C. D., The Effect of the Density of the surrounding Gas on the Discharge of Electrified Metals by X-rays, 791
CHILD, C. M., Centrosome and Sphere in the Ovarian Stroma of Mammals, 231; Cleavage of the Egg of Arenicola, 629
CHITTENDEN, J. B., Trigonometry, J. B. Lock, 626
CHITTENDEN, R. H., Microscopic Researches on the Formative Property of Glycogen, Charles Creighton, 517; Internal Secretions from a Chemico-physiological Standpoint, 969
Chittenden, R. H., The Proteolytic Action of Papain, 134, 902; Reaction of some Animal Fluids, 902; Protagon of the Brain, 909
Chree on Work at Kew Observatory, 666
CLARK, ALVAN G., On supposed Effects of Strain in Telescopic Objectives, 768
Clark, W. B., Upper Cretaceous Formations of the Northern Atlantic Coastal Plain, 94
CLARKE, F. W., Chemistry in the United States, 117
Classification, A Question of, ROBT. T. HILL, 921
Claypole, E. W., Human Relics in Ohio, 266
CLAYTON, H. HELM, Velocity of a Flight of Ducks obtained by Triangulation, 26; The Height and Velocity of the Flight of a Flock of Geese migrating Northward, 585
Clayton, H. Helm, Cloud Heights, 264
Climatic, Features of the Arid Regions, 469; Zones on the Island of Sakhalin, 469
Cloud Observations at Blue Hill, 468
Clouds over a Fire, R. DEC. WARD, 60
Clute, W. N., Scolopendrium, 631
Coast and Geodetic Survey, J., 384
COCKERELL, D. T. A., A Study in Insect Parasitism, L. O. Howard, 848; The Virginia Colony of Helix Nemoralis, 985
Codice Messicano Vaticano, D. G. BRINTON, 355
Cohn, F., Errors of Heliometer Measures, 303
COLE, F. N., American Mathematical Society, 99
Coleman, A. P., Anorthosites, 190
Colon Group of Bacilli, ADELAIDE WARD PECKHAM, 981
Color, Photography, 306; Blindness and William Pole, CHRISTINE LADD FRANKLIN, 310
Compliment or Plagiarism, BEMAN and SMITH. 61, 275, 478; GEORGE BRUCE HALSTED, 152, 344; ARTHUR LEFEVRE, 404
Comstock, Geo. C., Wave-length of Starlight, 522
Comstock, W. T., Molecular Rearrangement of the Oximes by Means of Metallic Salts, 926
COPE, E. D., The Inheritance of Acquired Characteristics, 633
Cope, Edward D., HENRY F. OSBORN, 705; Bequests of the late, 765
Coral Reef Committee, Report of, 258
Cornell Glacier, T. C. CHAMBERLIN, 748
Cornish, Vaughan, On Sand Dunes, 795
COUES, ELLIOTT, A Dictionary of Birds, Alfred Newton, 553
Coville on the Water Hyacinth, 811
Cowan, J. R. K., Tin in Canned Goods, 914
Crampton, Jr., H. E., Fertilization in Gasteropods, 320, 391; Ascidian Half Embryo, 595
Creighton, Charles, The Formative Property of Glycogen, R. H. CHITTENDEN, 517
CROOK, A. R., Northwestern University Science Club, 160
Crooks, Wm., Deforestation and Climate, 837; Psychics in the Study of Man, 871
CROSBY, W. O., The Great Fault and accompanying Sandstone Dikes of Ute Pass, Colo., 604.
Crosby, W. O., Geology of Newport Neck and Conanicut Island. 407; and M. L. Fuller on the Origin of Pegmatite, 486
Cross, Whitman, Leucite Hills, Wyo, 361
Culin, Stewart, Divinatory and Calendrical Diagrams, 100, 216; The Game of Mancala, 178
Curtis, H. S., Landscape Photography, 359
Cushing, A. R., Production of Idioventrical Rhythem in the Mammalian Heart, 905

CUSHING, FRANK HAMILTON, A Case of Primitive Surgery, 977.
Cycle in the Life of the Individual (Ontogeny) and in the Evolution of its own Group (Phylogeny), ALPHEUS HYATT, 161.

DABNEY, JR., CHAS. W., A National Department of Science, 73; The National University, 378
DALL, WM. H., Distribution of Marine Mammals, 843
DANA, CHARLES L., Genius and Degeneration, William Hirsch, 404
Darton, N. H., District of Columbia Region, 84; Dikes in Appalachian Virginia, 84
DAVENPORT, C. B., The Cell, Oscar Hertwig, 111; Edmund B. Wilson, 112
Davenport, C. B., Water in Growth, 892; Experimental Morphology, J. P. MCMURRICH, 923
DAVIS, W. M., Current Notes on Physiography, 20, 177, 263, 336, 437, 507, 577, 647, 722, 795, 869, 945; Journal of School Geography, 551
Davy-Faraday Research Laboratory, 54, 221
Dawson, C. F., Dissemination of Infectious Diseases by Insects, 629
Dawson, G. M., Annual Report of the Geological Survey of Canada, C. H. HITCHCOCK, 621
Dawson, W., Pre-Cambrian Fossils, 252
Day, H. D., Magnetic Increment of Rigidity of Wires in a strong Magnetic Field, 888
DEAN, BASHFORD, N. Y. Academy, Biology, 595
Dean, Bashford, Plan of Development of a Myxinoid, 435.
Deaths: Antoine T. d'Abbadie, 580; Duc d'Aumale, 800; Kristian Bahnson, 270; Edward Ballard, 270; A. D. Bartlett, 839; Edson S. Bastin, 617; A. A. van Bemmelin, 580; Theodore Bent, 839; Sir John Brown, 103; Jacob Breitenlohner, 653; C. B. Brush, 916; Alvan G. Clark, 950; Legrand des Cloizeau, 839; M. C. Contejean, 580; E. D. Cope, 616; Olaus Dahl, 473; Wilhelm Deeke, 270; Alfred Dewèore, 652; Wilhelm Doellen, 548; Robert Douglas, 916; Henry Drummond, 472; Ney Elias, 950; Charles Eliot, 548; Baron von Ettingshausen, 270; von Falke, 950; Edward Falkner, 56; Gallileo Ferraris, 304; Dr. Feulard, 839; A. W. Franks, 916; Karl R. Fresenius, 950; Heinrich Gätke, 181; Joseph v. Gerlach, 103; Emily L. Gregory, 728; Traill Green, 728: Horatio Hale, 56; E. Freiherr von Härdtl, 653; Charles Heitzmann, 103; Robert Hogg, 580; Ludwig Hollaender, 652, Joseph F. James, 580; Lorenzo N. Johnson, 442; G. A. Kenngott, 65; Peter D. Keyser, 473; David Kirnaldy, 304; F. W. Klatt, 652; Dr. Kolbe, 548; M. Carey Lea, 767; Martin L. Linell, 766; Victor Lemoine, 728; W. T. Lusk, 950; Leopold Maney, 989; Dr. de Marbaix, 728; J. Biddulph Martin, 580; Vivian S. Martin, 105; M. Martini, 270; Count de Mas-Latre, 103; F. J. Mouat, 223; T. P. Morawitz, 182; Fritz Müller, 989; Edward Thomson Nelson, 442; Hermann von Nordlinger, 304; G. Ossowski, 916; Wm. H. Pancoast, 103; Léon du Pasquier, 652; John Pierce, 442; Guiseppe Protonotari, 270; Emil Heinr. du Bois-Reymond, 22; Timothee Rothen, 472; Professor Saccardo, 223; Sinku Sakaki, 728; Prof. Sätherberg, 304; Dr. Schols, 652; J. L. Smith, 989; E. v. Sommaruga, 916; J. E. Stone, 839; Isidore Strauss, 161; A. Streng, 223; J. J. Sylvester, 472; Jean Hubert Thiry, 181; Luther H. Tucker, 473; Georges Ville, 472; W. Wallace, 340; Francis A. Walker, 102. W. H. Ward, 103; Joseph D. Weeks, 270; Karl Weierstrass, 472; C. F. Wiepken, 580; Theodore G. Wormley, 56; George Weyer, 181
Debus on Dalton's Atomic Theory, 179
Deforestation and Rainfall, 509
Deichmüller's Instrument for fixing the Position of the Zenith with the Meridian Circle, 222
Delafontaine on Deeply Colored Rare Earths, 915
Dellenbaugh, F. S., Death Masks, 393
Denning, W. F., Paths of 107 Meteors, 727
Dewey, Lyster, H., Migration of Weeds, 811
Dickinson, B. B., Geography in Schools, 178
Diller, J. S., Crater Lake, 81, 406, 947; Northwestern Oregon, 263
Discussion and Correspondence, 25, 60, 107, 147, 185, 226, 275, 308, 343, 400, 446, 476, 515, 550, 585, 620, 656, 694, 731, 768, 804, 843, 877, 919, 955, 993
Dobbin on the Introduction of the Balance into Chemistry, 394
Documents Public, Report on, 399
DODGE, CHARLES WRIGHT, The Principles and Practice of Teaching, James Johonnot, 187; Nature Study and Related Subjects for Common Schools, Wilbur S. Jackman, 188
DODGE, RICHARD E., Earth Sciences, 503; Journal of School Geography, 552; Geology, N. Y. Academy of Sciences, 560, 607, 702, 890
Dogs of the Ancient Pueblos, F. A. LUCAS, 544
Dolbear, A. E, First Principles of Natural Philosophy, 805
Dorsey, George A., The Lumbar Curve, 579
Dreyer, G. P., Supra-renal Capsules, 905
'Driftless' Ridge, O. H. HERSHEY, 696
Druidical Remains at Dartmoor, 57, 272
Dryer, C. R., Physiography of N. Indiana, 724
DUDLEY, C. B., Some present Possibilities in the Analysis of Iron and Steel, 241
Dudley, P. H., Railway Tracks, 359
Dudley, Wm. L., Action of Fused Sodium Dioxid on Metals, 394
Duff, A. Wilmer, Viscosity as a Function of Temperature, 485; Tidal Observations, 739
Duhem, P., Traité élémentaire de mécanique chimique, WILDER D. BANCROFT, 625
Dunlap, F. L., and I. K. Phelps, Urea and Primary Amines and Maleïc Anhydride, 963
Dunnington, F. P., Laboratory of Analytical Chemistry, 521
Durand, W. F., Entropy of Function, 316
Dutch Association for Advancement of Science, 992
Duty on Books devoted to Original Research, 224
Dwelshauvers-Dery, V., Étude de huit essais de machinè à vapeur, R. H. THURSTON, 153

EARLE, CHARLES, Relations of Tarsius to the Lemurs and Apes, 258; Further Considerations of the Systematic Position of Tarsius, 657
Earth-crust Movements and their Causes. JOSEPH LECONTE, 321
Eastman, C. R., Devonian Bone and Fish-beds of North America, 703; Ctena-canthus spines from the Keokuk Limestone, 998

EASTMAN, J. R., Relations of Science and the Scientific Citizen to the General Government, 525
Ebert on the Possible Disruption of the Solar System, 303
Economic Association, The American, 56
Eichhorn, A., Mayan Hieroglyphs, 798
Elective Studies in American Universities, 308, 445
Electric, Omnibus, 183; Light Association, 953
Elizabeth Thompson Science Fund, 800
Emmens, Stephen H., The Argentaurum Papers, W., 314
Emmerling, O., Arsenic in Wall Papers, 101
EMMONS, S. F., Geology of Government Explorations, 1, 42
Emmons, S. F., Physiography of West Coast of Peru, 889
Engineers Civil, Society, of France, 271, 841, London Institute of, 617, 918
Entomological Society of Washington, L. O. HOWARD, 237, 559, 856
ESTES, LUDOVIC, Poudré, 805
Ethno-Botany, 688
Ethnography of Madagascar, 871
Etruscology, Recent, 614
Euproctis Chrysorrhœa in Massachusetts, SAMUEL HENSHAW, 845
Expeditions, 28, 57, 143, 145, 183, 224, 269, 273, 443, 474, 512, 581, 653, 655, 728, 765, 839, 840, 841, 874, 875, 916, 917, 951, 952, 989
Exploration on the Coasts of the North Pacific Ocean, 455
Eycleshymer and B. M. Davis, Epiphysis and Paraphysis in Amia, 774

F., E. B., Astrophysical Notes, 726, 764, 886
F., G. W., Physical Educational Review, 666
Fairbanks, Harold W., Geology of San Francisco Peninsula, 283; Contact Metamorphism, 998
Fairchild, H. L., Shore Lines of Lake Warren, 88
FARRAND, LIVINGSTON, The American Psychological Association, 206; Anthropology and Psychology, N. Y. Academy of Sciences, 283, 776
Fault, the Great, and accompanying Sandstone Dykes of Ute Pass, Colo., W. O. CROSBY, 604
Fauna of Central Borneo, G. R. STETSON, 640
Fear, The Study of, WESLEY MILLS, 153
FERNOW, B. E., Forest Reservation Policy, 489, 868
Fewkes, J. W., Types of Pueblo Pottery, 195
Field, G. W., Plankton of Brackish Water, 424
FISHER, A. K., Sharp-tailed Finches of Maine, 577
Fisheries, Congress, National, 653; Exhibition, International, 918
Fleet, An Imaginary, G. D. HARRIS, 586
FLETCHER, ALICE C., Notes on certain Beliefs concerning Will Power among the Siouan Tribes, 331
Fletcher, Alice C., Early Forms of Ceremonial Expression, 215; Ceremonial Hair-cutting among the Omahas, 215
Flexner, Simon, Blood Serum in Animals immune from certain Diseases, 193
Flight of a Flock of Geese, The Height and Velocity of, H. HELM CLAYTON, 585
Florida Monster, A. E. VERRILL, 392, 476; F. A. LUCAS, 476
Folin, O., On Urethanes, 852
Folk-lore Society, The American, HARLAN I. SMITH, 215
Fonvielle, de, Balloon Meteorology, 265
Foote, Katherine, Centrosome and Archyplasm, 231
Forest Reservation, 398, 654, 764, 800, 839, 893; Policy, P. E. FERNOW, 489, 868
Förstemann on Mayan Hieroglyphs, 871
Francoit-Legall, on the Amerique Indians, 438
FRANKLIN, CHRISTINE LADD., Color Blindness and William Pole, 310
Franklin, W. S., Electricity and Magnetism, 485
Franz, S. I., Visual After-images, 776
Frazer, Persifor, the Determination of Minerals by Physical Properties, E. B. MATHEWS, 624

GAGE, S. H., N. Y. State Science Teachers' Association, 458
Galloway, B. T., Effect of Environment on Host and Parasite in Certain Diseases of Plants, 963
Ganodonta, H. F. O., 611
Geikie, Sir Archibald, The Recent Visit of, J. F. KEMP, 785; The Tertiary Volcanic Succession, W. F. MORSELL, 788
Generic Names, Ictis, Arctogale and Arctogalidia, C. HART MERRIAM, 302
Geographentag, XII. Deutscher, Jena, 1897, F. P. GULLIVER, 866
Geographical, Society, Royal, of London, 103; Association of English Schoolmasters, 178; Congress, International, 271; Magazine, ISRAEL C. RUSSELL, 477; Society, Royal, 306
Geography, Journal of School, 105; ISRAEL C. RUSSELL, 271; W. M. DAVIS, 551, RICHARD E. DODGE, 552; French, Notes on, F. P. GULLIVER, 644
Geologic Atlas of the United States, 884
Geological, Society of America, J. F. KEMP, 81; Winter Meetings at Washington, 342; Society of London, Award of Medals, 182; Club of the University of Minnesota, CHARLES P. BERKEY, 196, 363, 487; Society of Washington, W. F. MORSELL, 238, 361, 558, 811, 898; International Congress, 581, 616, 767, 800, 989; Survey of Colorado, 582; Work of the U. S. Survey, 991
Geologist, American, 229, 358, 486, 854
Geology, of Government Explorations, S. F. EMMONS, 1, 42; Journal of, H. F. B., 190, 282, 519, 701, 925; N. Y. Academy of Sciences, J. F. KEMP, 239, 360; RICHARD E. DODGE, 560, 702, 890; at the British Association, W. W. WATTS, 252; Introduction of New Terms in, JOHN C. BRANNER, 912
'Gibbers,' J. B. WOODWORTH, 476
Gibbs, J. W., Hubert A. Newton, 738
GIBBS, WOLCOTT, A Lecture by Regnault, 409
GIDDINGS, FRANKLIN H., Spencer's Principles of Sociology, 732; The Crowd, Gustav Le Bon, 734
Giesel, F., Solid Solutions, 470
GILBERT, G. K., Simplified Spelling, 185; Catalogue des bibliographies géologiques, Emm. de Margerie, 187
Gilbert, G. K., Tracks of Erian Drainage, 88; Underground Water of the Ark. Valley, 336
GILL, THEO., Distribution of Marine Mammals, 955
GILPIN, J. ELLIOTT, American Chemical Journal, 157, 356, 520, 664, 852, 961
Gilpin, J. Elliott, Phosphorus Pentachloride, 853
Glacial Man in Ohio, CLARENCE B. MOORE, 880
Glaciers of Norway, 21
Glossophaga Truei, HARRISON ALLEN, 153

Gomme, G. L., Folk-lore as Ethnological Data, 545
Goode, Memorial Meeting, CYRUS ADLER, 365; George Brown, S. P. LANGLEY, 369; as a Naturalist, HENRY F. OSBORN, 373
GOODE, J. PAUL, So-called Pseudo-Aurora, 186
Goodman, J. T., Biologia Centrali-Americana: Archæology, D. G. BRINTON, 662
GRABAU, AMADEUS W., The Sand-plains of Truro, Wellfleet and Eastham, 334
Graf, Arnold, Individuality of the Cell, 388
GREEN, BERNARD R., Philosophical Society of Washington, 408
Greene, C. W., Nerve Impulse, 910
Greenland, Glaciers, Former Extension of, RALPH S. TARR, 344; T. C. CHAMBERLIN, 400; EDWARD H. WILLIAMS, JR., 448; Former Extension of Ice in, R. S. TARR, 515, 804; T. C. CHAMBERLIN, 516
Gregory, Emily Ray, Pronephric Duct in Selachians, 1000
Griffin, J. J., The Diazo Compounds, 520
Grindley, H. S., and J. L. Sammis, Action of Mercaptides on Quinones, 665
Groos, Karl, Die Spiele der Thiere, J. MARK BALDWIN, 347
Gross, Theodor, Bythium, 874
Growth of Children, FRANZ BOAS, 570
GULLIVER, F. P., Notes on French Geography, 644; XII Deutscher Geographentag, Jena, 866
Guntz on Lithium Nitrid, 180, 266

H., J. L., Notes on Inorganic Chemistry, 101, 179, 221, 266, 394, 439, 470, 545, 615, 651, 725, 763, 798, 872, 914
Haase, Erich, Researches on Mimicry, VERNON L. KELLOGG, 228
Haber, F., and A. Weber, on Illuminating Gas, 266
Hale, George E., Refracting and Reflecting Telescopes for Astrophysical Investigations, 592
Hale, Horatio, D. G. BRINTON, 216; on Wampum Records, 650
Hall, C. W., The University of Minnesota, 730
Hall, J. V., Ferric Hydroxide, 962
HALLOCK, WILLIAM, Astronomy and Physics, N. Y. Academy of Sciences, 70, 359, 452
HALSTED, GEORGE BRUCE, Compliment or Plagiarism, 152, 344; International Congress of Mathematicians, 477; Sylvester, 597
Hann's Allgemeine Erdkunde, 177
Hannequin, Arthur, L' hypothèse des atomes dans la science contemporaine, E. A. STRONG, 736
Harley, W. N., and H. Ramage, Spectrographic Analysis, 546
Harmon, Mary P., Psycho-physical Tests, 210
Harrington, D. W., Heart of the Guinea Pig, 907
Harrington, N. R., Entoconchidæ, 433; A Nereid from Puget Sound, 595
HARRIS, G. D., An Imaginary Fleet, 586
Hart, Edward, Chemistry for Beginners, JAS. LEWIS HOWE, 155
Hartley W. N., and H. Ramage, The wide Dissemination of some the rarer Chemical Elements, 394
HATHAWAY, A. S., Non-Euclidean Geometry, John Bolyai, 311.
Hathaway, A. S., Primer of Quaternions, ALEXANDER MACFARLANE, 699
Hayes, C. Willard, Solution of Quartz under Atmospheric Conditions, 82; and Alfred H. Brooks, Crystalline and Metamorphic Rocks 97; Southern Iron Ores, 558
HAZEN, H. A., Pseudo-Aurora Again, 447
Heilprin, Angelo, Earth and its Story, 21; Assumed Glaciation of the Atlas Mountains, 88
Helix Nemoralis, The Virginia Colony of, T. D. A. COCKERELL, 985
Henchman, A. P., Eyes of Limax Maximus, 428
HENSHAW, SAMUEL, Boston Society of Natural History, 34, 72, 196, 361, 632, 703, 891, 964; Euproctis Chrysorrhœa in Massachusetts, 845
Herreshoff, J. B., Metallurgy of Copper, 240
HERSHEY, O. H., The Quaternary Deposits of Missouri, James E. Todd, 587; A 'Driftless' Ridge, 696; The Loess Formation of the Mississippi Region, 768
Hershey, O. H., The Formation of Till, 283
Hertwig, Oscar, The Cell, C. B. DAVENPORT, 111
Heycock, C. T., Metallic Alloys, 693; and F. H. Neville, Sodium-gold Alloys, 914; Alloy of Silver and Zinc, 948
Hieroglyphs, Mexican, J. D. McGUIRE, 479; ZELIA NUTTALL, 479
Highhole Courtship, HIRAM M. STANLEY, 921
HILL, ROBT. T., Phases in Jamaican Natural History, 15; A Question of Classification, 921
Hill, R. T., Phases of the Negro of the West Indies, 594; and T. W. Vaughan, Lower Cretaceous Gryphæas of the Texas Region, 629
Hillgartner, H. L., Experiments with X-Rays on the Blind, 704
Hillyer, N. H., and O. E. Crooker, Aluminum Ethylate, 157
Hime, H. W. L., Anwendung der Quaternionen auf die Geometrie, ALEXANDER MACFARLANE, 699
Hirsch, William, Genius and Degeneration, CHAS. L. DANA, 404
HITCHCOCK, C. H., Annual Report of the Geological Survey of Canada, G. M. Dawson, 621
Hitchcock, C. H., Stratigraphy of certain Homogenous Rocks, 86.
Hobbs, W. H., Geology of Southwestern New England, 520
Hodge, C. F., Physiological Influence of Alcohol, 135
Hoffman, Frederick L., Race Traits and Tendencies of the American Negro, W J McGEE, 65
HOLDEN, EDWARD S., The Bruce Astronomical Medal, 620; Mr. Lowell's Observations of Mercury and Venus, 656; The Beginnings of American Astronomy, 929
HOLGATE, THOMAS F., Science Club of Northwestern University, 524, 812
Hollick, Arthur, Geological Section at Cliffwood, N. J., 239; Fossil Arundo from S. I., 595
Holm, Theo., Draba hyperbores, 236; The Grass Embryo, 668
Hough, T., Duration of Cardiac Standstill with different Strengths of Vagus Stimulation, 12
HOWARD, L. O., Entomological Society of Washington, 237, 559, 856
Howard, L. O., Parasites of Shade Tree Insects, 319; Parasites of Coccidæ, 560; A Study in Insect Parasitism, D. T. A. COCKERELL, 848
HOWE, JAS. LEWIS, Chemistry for Beginners, Edward Hart, 155; Theoretical Chemistry, Ferdinand G. Wiechmann, 313

Howell, W. H., Plethysmographic Curves 130; Physiological Effects of Injections of Extracts of the Hypophysis Cerebri, 903
Huber, G. C., Sympathetic Ganglia of Vertebrates, 132; Ending of Nerves in Muscle Tissue, 133; in the Viscera, 908; in the 'Muscle Spindles' of Voluntary Muscle, 908
HUBRECHT, A. A. W., Relations of Tarsius to the Lemurs and Apes, 550
Huggins, William, Stellar Spectra on a Photographic Plate, 522
Hull on the Glacial Period, 257
Humphreys, W. J., Wave-lengths of the Lines of the Arc Spectra of certain Elements, 521
Hunt., R., The Inhibitory and the Accelerator Nerves of the Heart, 130; Innervation of the Heart of the Opossum, 906; The Lobster's Heart, 907
Huntington, G. S., Lemur Bruneus, 319
Hutchinson, H. N., Prehistoric Man and Beast, D. G. BRINTON, 154
Huxley Memorial, 223
HYATT, ALPHEUS, Cycle in the Life of the Individual (Ontogeny) and in the Evolution of its own Group (Phylogeny), 161
Hygiene, Public, Report on, in Prussia, 442
HYSLOP, JAMES H., Professor Jastrow's Test on Diversity of Opinion, 275

Ice Age, The Coming, C. A. M. TABER, 658
India, Survey of, 184
Induction Coil, A New Method of driving an CHAS. L. NORTON, RALPH R. LAWRENCE, 335
Insects, An Essay on the Classification of, JOHN B. SMITH, 671
Iowa Academy of Sciences, HERBERT OSBORN, 317
Iron and Steel, Some present Possibilities in the Analysis of, C. B. DUDLEY, 241
Irving, J. D., Green River and the Uinta Mountains, 647

J., Coast and Geodetic Survey, 384
J., H., Astronomical Notes, 102, 180, 222, 303
Jackman, Wilbur S., Nature Study, CHARLES WRIGHT DODGE, 188
Jackson, C. L, and M. H. Ittner, Parabromdimetanitrolouol, 157; Sodic Ethylate, 520; and A. M. Comey, Hydrozel, 651; Hydrocobaltocobalticyanic Acid, 664
Jacoby, H., Circumpolar Stars, 359
Jaggar, Jr., T. A., Mountain Building, 703
Jamaican Natural History, ROBT. T. HILL, 15
JAMES, WILLIAM, Louis Agassiz, 285
JASTROW, JOSEPH, A Test on Diversity of Opinion, 26; Outlines of Psychology, Wilhelm Wundt; Edward Bradford Titchener, 882
Johns Hopkins University Science Club, CHAS. LANE POOR, 192, 318, 667
Johnson, J. B., The Materials of Construction, MANSFIELD MERRIMAN, 921
Johnson-Lavis, H. J., Highwood Mountains, 256
Johonnot, James, The Principles and Practice of Teaching, CHARLES WRIGHT DODGE, 187
Jones, H. C. and E. Mackay, The Study of Water Solutions and of some of the Alums, 356
Jones, H. L. Seashore Plants, 964
JORDAN, EDWIN O., Municipal Government in Continental Europe, Albert Shaw, 450
Judson, W. V., Galveston Harbor, 363
Jurassic Wealden (Tithonian) of England, JULES MARCOU, 149

Kastle, J. H., Salts of Calcium, Strontium and Barium, 665; and W. A. Beatty, Effect of Light on the Displacement of Bromine and Iodine, 357; Halogens in Organic Halides, 845
Kayser, H., Spectrum of Zeta Puppis, 591
Keilhack, K., Prof. Geikie's Classification of the North European Glacial Deposits, 519; Thorodssen on Northeast Iceland, 796
Keith on Some Stages of Appalachian Erosion, 507
KELLOGG, VERNON L., Researches on Mimicry, Erich Haase, 228
Kelly, D. J., Malt Wine, 774
KELVIN, LORD, J. G. BEATTIE, M. SMOLUCHOWSKI DE SMOLAN, Electrification of Air by Röntgen Rays, 139
Kemp, G. T., Apparatus to Avoid Explosion in Gas Analysis, 132; Physiological Action of Nitrous Oxide, 136; Gases of the Blood during Nitrous Oxide Anæsthesia, 904
KEMP, J. F., Geological Society of America, 81; N. Y. Academy of Sciences, Geology, 239, 360, 999; Visit of Sir Archibald Geikie, 785
Kemp, J. F., The Leucite Hills, Wyo., 82; The Pre-Cambrian Topography of the Eastern Adirondacks, 92; Ore deposits of Butte, Mont., 891; Geology of the Trail from Redrock to Leesburgh, Idaho, 891
Kendall on Changes in Yorkshire Rivers, 257
Kenyon, F. C, Brain of the Bee, 358; Optic Lobes of a Bee's Brain, 429
Kimball, James P., Puget Sound Basin, 854
King, F. H., Movements of Ground Waters, 523
Kingsbury, B. F., The Oblongata in Fishes, 773
Kingsley, J. S., Amphiuma and Cœcilians, 436
Klebs, George, Bedingungen der Fortpflanzung bei einigen Algen und Pilzen, GEO. F. ATKINSON, 353
Knight, N., Benzanilide, 357
Knowlton, F. H., Flora of Independence Hill, 190
Kober, George M., Hygiene, 856
Kölliker's Entwicklungsgeschichte, 342
Krause, E. H. L., Pre-history of N. Europe, 689
Kuhlenbeck, L., Native American Mysticism, 579
Kümmel, Henry B., Newark Formation of Western New Jersey, 93
Kunz, George F., Precious Stones, 184

L., F. A., Color Change in the Plumage of Birds unaccompanied by Moult, 762
Lachman, A., Zinc Ethyl, 854
Landslip, in Switzerland, 21; The Gohna, 437; on the Banks of the Upper Yang-tsze, 619
LANE, ALFRED C., The Drainage of the Saginaw Valley, 553
Lane, Alfred C., The Grain of Rocks, 97
Langdon, F. E., Peripheral Nervous System of Nereis Virens, 427
LANGLEY, S. P., George Brown Goode, 369
Lassar-Cohn, Die Chemie im täglichen Leben, W. R. O., 156
Lavoisier Monument, EDGAR F. SMITH, 403
Lay, W., Mental Imagery, 776
LeBlanc, Max, The Elements of Electrochemistry, FERDINAND G. WIECHMANN, 32
Le Bon, Gustave, The Crowd, FRANKLIN H. GIDDINGS, 734

LE CONTE, JOSEPH, Earth-Crust Movements and their Causes, 321
LEE, FREDERIC S., The American Physiological Society, 129, 900
Lee, F. S., Form of the Muscle Curve, 910
Leeds on Micro-organisms in Water, 71
LEFEVRE, ARTHUR, Compliment or Plagiarism, 401
Lefevre, G., Budding in Clavilinidæ, 433
Leonard, A. G., Natural Gas, 317
Letourneau, Ch., L'evolution de l'esclavage, D. G. BRINTON, 448
Leverett, Frank, Changes of Drainage in the Ohio River Basin, 85; An Abandoned River Channel in Eastern Iowa and the Western Edge of the Illinois Icelobe, 89; Glacial Deposits of Indiana, 263; The Preglacial Kanawha, 337
Lillie, F. R., Origin of Centers of the First Cleavage Spindle in Unio Complanata, 389
Lindgren, Waldemar, Sierra Nevada, 190, 361, 590
Littleton, F. T., Volumetric Determination of Starch, 157
Liversidge on Gold in Natural Saline Deposits, 470
Lock, J. B., Trigonometry for Beginners, J. B. CHITTENDEN, 626
LOCKE, F. S, Physiological Papers, H. Newell Martin, 113
Locke, F. S., Latent Period of the Motor Nerve-endings, 136; The Frog's Heart, 137
Loess, Formation of the Mississippi Region, OSCAR H. HERSHEY, 768; Is it of either Lacustrine or Semi-marine Origin? 993
Loomis, E. H., The Freezing Points of Dilute Aqueous Solutions, 315
Losanitsch and Jovitschitsch, Silent Electric Discharge, 440
Lough, James E., Intensity of Sensation, 207
Lowell's, Mr., Observations of Mercury and Venus, EDWARD S. HOLDEN, 656
LUCAS, F. A., Biological Society of Washington, 159, 236, 319, 487, 629, 688, 739, 810, 963; The Florida Monster, 476; Play of Animals: the Fur Seal, 480; Museums and Science, 543; A Dog of the Ancient Pueblos, 544; Professor Scott's Bird Pictures, 620
Lucas, F. A., Sea-lion Eumetopias, 159; Natural Mortality among fur Seals, 159
Lusk, G., Production of Sugar from Gelatine in Metabolosm, 132; Phlorhizin Diabetes, 900
Lydekker, R., A Geographical History of Mammals, C. HART MERRIAM, 26.

M., Henry L. Whiting, 300
M., C. H., A Popular Handbook of the Ornithology of Eastern North America, Thomas Nuttall, 110; Birds of the Galapagos Archipelago, Robert Ridgway, 770; Earliest Published Note of the late Chas. E. Bendire, 805
M., W. F., Magnetic Declination, 444
McG., J. H., Semon on the Monotremes, 643
Mabery, Chas. F., and E. J. Hudson, American Petroleum, 664; and A. S. Kittelberger, South American Petroleum, 853, 961
McAdie on Fog Possibilities, 265
McCalley, Henry, Tenn. Valley Region, Ala., 507
MACALLUM, A. B., Toronto Meeting of the British Association, 251
McCauley, A., Utility of Quaternions in Physics, ALEXANDER MACFARLANE, 699
McCLURE, C. F. W., Primary Segmentation of the Brain, 260
McCORMICK, J. H., Anthropological Society of Washington, 35, 194, 487, 594, 856, 927
McCormick, J. H, Folk-lore for 1896, 195; Development of the Arts as Applied to Medicine, 220
MACDOUGAL, D. T., A New Botanical Laboratory in the American Tropics, 395
MacDougal, D. T., On the Tropical Laboratory Commission, 728
MACFARLANE, ALEXANDER, Recent Books on Quaternions, 699
MACFARLANE, JOHN M., Inheritance of Acquired Characteristics, 935
McGEE, W J, Race Traits and Tendencies of the American Negro, Frederick L, Hoffman, 65
McGee, W J, Sheetflood Erosion, 722; The Muskwaki Indians, 928
McGregor, J. H., Embryo of Cryptobranchus, 71
McGUIRE, J. D., Mexican Hieroglyphs, 479
McGuire, J. D., Primitive Drills and Drilling, 54
M'Kendrick, J. G., Elementary Human Physiology, JOSEPH W. WARREN, 809
McMURRICH. J. P., Experimental Morphology, Chas. B. Davenport, 293
McMurrich, J. P., The Midgut in Terrestrial Isopods, 423
McNAIR, F. W., Newton's Total Reflection Experiment, 620
Man and his Environment, 947
MARCOU, JULES, The Jurassic Wealden (Tithonian) of England, 149
Marcou, Jules, Stratigraphic Classification, 230
Margerie, Emm. de, Catalogues des bibliographies géologiques, G. K. GILBERT, 187
Marine, Biology of Great Britain, 55; Fauna of S. African Coast, 443; Mammals, Distribution of, P. L. SCLATER, 741; WM. H. DALL, 843; THEO. GILL, 955; G. BAUR, 956; ARNOLD E. ORTMANN, 957
Marlatt, C. L., The Science of Entomology, 559
Marr, J. E., Stratigraphical Investigation, 252
Marsh, O. C., Stylinodontia, 229
MARSHALL, WM. S., University of Wisconsin Science Club, 160, 408, 523, 632
Martin, Edward A., The Story of a Piece of Coal, J. J. STEVENSON, 810
Martin, H. Newell, Physiological Papers, F. S. LOCKE, 113
Martin, R., Racial Studies in Switzerland, 22
Mason, O. T., Primitive Travel and Transportation, 141; Mateo Grosso, S. Amer. as a Mingling Ground of Stocks, 194; Boat from the Kootenay River, 927
Mason, W. P., Qualitative Analysis, W. A. N., 280
Mathematical. Society, American, F. N. COLE, 99; 917; Conference at Chicago, 398
Mathematicians, International Congress of, GEORGE BRUCE HALSTED, 477; 841
Mathematics, Higher, ALEXANDER ZIWET, 277; History of Elementary, FLORIAN CAJORI, 516
MATHEWS, ALBERT, Internal Secretions, in Relation to Variation and Development, 683
MATHEWS, E. B., The Determination of Minerals by Physical Properties, Persifor Frazer, 624
Mathews on Early Cambrian Faunas, 254
Matthews and Shearer, Problems and Questions in Physics, 805
Maury, A. C., Spectra of the Brighter Stars, 836

Mayan History, Ancient, 53
Mayer, A. M., Flotation of Disks and Rings of Metal, 589
Mead, A. D., The Centrosomes in the Annelid Egg, 232; on Centrosomes in Chœtopterus, 389
MEARNS, EDGAR A., A New Subgeneric Name for the Water Hares, 393
Medical, Inspectors in New York Schools, 23; Schools, N. Y. Licensing examinations of, 107; Association, British, 729, 840, 951; The American, 917; International Congress, 989
MEEK, S. E., Naples Zoological Station, 832
MELTZER, S. J., Emil Du Bois-Reymond, 217
Meltzer, S. J., Contraction of the Stomach, 131; Bactericidal Effects of Lymph from the Thoracic Duct, 136; Deglutition, 901
MENDEL, LAFAYETTE B., Professor Eugene Baumann, 51
MERCER, H. C., Potter's Wheel in Ancient America, 919
MERRIAM, C. HART, A Geographical History of Mammals, R. Lydekker, 26; Charles E. Bendire, 261; The Generic Names Ictes, Arctogale and Arctogalidia, 302; Type Specimens in Natural History, 731; Suggestions for a New Method of discriminating between Species and Sub-species, 753
Merriam C. Hart, Pribilof Island Hair Seal, 319
Merrill, G. P., Rock Weathering, 95; Rocks, Rock-Weathering and Soils, J. B. WOODWORTH, 995
MERRIMAN, MANSFIELD, The Materials of Construction, J. B. Johnson, 921
Merritt, Ernest, The Gyroscopic Pendulum, 316
Metabolism in the Human Body, 493
Meteorological, and Hydrological Meetings, The International, A. LAWRENCE ROTCH, 17; Conference at Paris, A. LAWRENCE ROTCH, 152; Society, The Royal, 274; Society, American, 295; Reprints, R. DEC. WARD, 339, 661; Station. Antarctic, 341; Council of Royal Society, 583; Observatory, The Blue Hill, 613
Meteorology, Current Notes on, R. DEC. WARD, 219, 264, 337, 468, 508, 612, 649, 837, 986
Metric System, 307, 513, 692, 953; BURT G. WILDER, 587
Miall, L. C., Round the Year, E. S. MORSE, 227
Michaelis and Becker on Phosphorous Acid, 949
Michelson, A. A., Earth and Ether, 889
Microbes, The War with the, E. A. DE SCHWEINITZ, 561
Microtomes, Automatic, On two Forms of, CHARLES SEDGWICK MINOT, 857
MILLER, JR., GERIT S., Migration of Bats on Cape Cod, Mass., 541
Millet, J. B., Kite-flying, 837
MILLS WESLEY, The Study of Fear, 153; Psychology and Comparative Psychology, 718; Significance of Internal Secretion, 920
Mills, W., Cerebral Cortex 134; Psychic Development of Young Animals, 209; Personal Experiences under Ether, 210
Milne, John, Earthquake Survey of the World, 146; Seismological Investigation Committee, 444
MINOT, CHARLES S., On Certain Problems of Vertebrate Embryology, 107; On Two Forms of Automatic Microtomes, 857
Minot, C, S., An Improved Microtome, 106; Laboratory Methods, 391
Mixter, W. G., Electrosynthesis, 999
Molenbroeck, P., Theorie der Quaternionen, ALEXANDER MACFARLANE, 699
Moler, George S., Synchronous Motor, 485
Mollier, H., The Celts and their Wanderings, 988
Monist, The, 69
Moore, B. E., The Lead Cell, 484; and H. V. Carpenter, The Galvanic Cell, 316
MOORE, CLARENCE B., Glacial Man in Ohio, 880
MORGAN, C. LLOYD, Organic Selection, 994
Morley, Frank, The Construction of a Single Point Covariant with five given Points, 99
Morphological Society, The American, G. H. PARKER, 388, 423
Morrill, A. D., The Auditory Epithelium, 358
MORSE, E. S., Round the Year, L. C. Miall, 227
Morse, E. S., 'Bow-pullers' of Antiquity, 614
MORSELL, W. F., Geological Society of Washington, 238, 361, 558, 811, 889; Sir Archibald Geikie on Tertiary Volcanic Succession, 788
Mortillet, G. de, on Small Chipped Flints, 339; European 'Quaternary Man,' 509; L'Origine de la Nation Française, 961
Morton on the Phenomena of Fluorescence, 71
Munby, A. E., Bunsen Burner for Acetylene, 914
Munroe, Chas. E., Gun Cotton, 115
Murray, John, 'Balfour Shoal.' 727
Museum, South Kensington and Queen Victoria's Jubilee, 397; The National, of Costa Rica, 470; British, Organization of the, 693
Museums, Associations, 580; How retard the Advance of Science, F. A. BATHER, 677

N., W. A., Development of the Periodic Law, F. P. Venable, 280; Notes on Qualitative Analysis, W. P. Mason, 280; Quantitative Chemical Analysis, Frederick A. Cairns, 281
Nansen's Discovery of the Breeding Grounds of the Rosy Gull, T. S. PALMER, 175
National, University, 197; WILLIAM TRELEASE, 345; CHARLES W. DABNEY, JR., 378; and the Smithsonian Institution, BENJ. IDE WHEELER, 881; Academy of Sciences, 659, 758
Natrix Grohamii, B. & G., FRANK C. BAKER and FRANK M. WOODRUFF, 447
Natural, History, Specimens, Postal Laws concerning, 873; History, Cambridge, W. McM. WOODWORTH, 958
Nebraska Academy of Sciences, G. D. SWEZEY, 158
Nedel, E., Antiquities of Bornholm, 988
Neissl, G. von, Paths of 100 Meteors, 727
Neurology, Journal of Comparative, 358, 773; and Psychiatry, etc., International Congress of, 839
New Books, 72, 116, 240, 284, 320, 364, 408, 488, 524, 560, 596, 668, 704, 776, 812, 892, 964, 1000
NEWCOMB, S., An Ambitious 'Paradoxer,' 400; The Problems of Astronomy, 777
Newcomb, S., Address by Prof. W. H. Welch in honor of, 690
Newell, W. W., The Legend of the Holy Grail, 215
Newton on the Worship of Meteorites, 33
Newton, Alfred, A Dictionary of Birds, ELLIOTT COUES, 533
New York Academy of Sciences, Astronomy and Physics, W. HALLOCK, 70, 359, 452; Biology, C. L. BRISTOL, 71, 319; BASHFORD DEAN, 595; Geology, J. F. KEMP, 239, 360, 999; Psychology and Anthropology, LIVINGSTON FARRAND, 283, 776; RICHARD E. DODGE, 560,

702, 890; Annual Reception and Exhibition of, 341; RICHARD E. DODGE, 607
Nicholas, F. C., Gold Fields of W. Columbia, 360
Nichols, E. F., A Method for Energy Measurements in the Infra-red, 315
NICHOLS, E. L., The Teaching of Physics and Chemistry in the Secondary Schools, 464
Nichols, E. L., Outlines of Physics, 805; and J. A. Clark, Electrification and Surface Tension of Water, 483; and W. S. Franklin, Physics, 805
Nichols, H. W., The Genesis of Clay Stones, 854
Nobel Bequest, 59, 103, 142, 223
Nomenclature, and Metamorphic Lavas, H. W. TURNER, 226; Scientific, A Layman's Views on, THEODORE ROOSEVELT, 683
Northwestern University Science Club, A. R. CROOK, 160; THOMAS F. HOLGATE, 524
NORTON, CHAS. L., RALPH R. LAWRENCE, A New Method of driving an Induction Coil, 335; An Induction Coil Method for X-Rays, 496
Norton, J. B. S., St. Louis Tornado of 1896, 893
Noyes, A. A. and C. W. Lucker, Diacetylenyl (Butadüne), 357
Nuttall, Thomas, A Popular Handbook of Ornithology, C. H. M., 110
NUTTALL, ZELIA, Mexican Hieroglyphs, 479

O., H. F., The Ganodonta, 611
O., W. R., Die Chemie im täglichen Leben, Lassar-Cohn, 156
OBERHOLSER, HARRY C., Bird Life, Frank M. Chapman, 997
Oberholser, H. C., American Golden Warblers, 740
Oberhummer on the Jewish Physical Type, 650
Opinion, A Test on the Diversity of, JOSEPH JASTROW, 26; JAMES H. HYSLOP, 275; 513
OSBORN, HENRY F., Goode as a Naturalist, 373; Origin of the Teeth of the Mammalia, 576; Edward D. Cope, 705
OSBORN, HERBERT, Iowa Academy of Sciences, 317
Organic Selection, J. MARK BALDWIN, 634; ROBERT M. PIERCE, 844; C. LLOYD MORGAN, 994
Orndorff, W. R., and C. B. Moyer, Naphthalene Tetrabromide, 664
ORTMANN, ARNOLD E., Distribution of Marine Mammals, 957

Palmer, Jr., A. de Forest, The Pressure Coefficient of Mercury Resistance, 998
PALMER, T. S., Nansen's Discovery of the Breeding Grounds of the Rosy Gull, 175
Pammel, L. H., Ecological Notes, 362
'Paradoxer,' An Ambitious, S. NEWCOMB, 400
Parasitism in the Cowbird, O. WIDMANN, 176
Pareiasauria Seeley (Cotylosauria Cope) from the Triassic of Germany, G. BAUR, 720
Paris Exposition of 1900, 693, 989
PARKER, G. H., The American Morphological Society, 388, 423
Parker, H. C., Measuring Currents, 70
Pasteur, Mausoleum, 56; Interment, 103; Statue, 304
Patents, British, Two Extraordinary, H. CARRINGTON BOLTON, 401
Patten, W., Preservation of Cartilage, 392; Visual Centers of Arthropods and Vertebrates, 431
Paul and Krönig on the Behaviour of Bacteria towards Solutions of Salts, 440
Paulitschke on the African Dwarfs, 510
Pawlewski on Sulfurylcloride, 763
Payne, G. F., Mineral Constituents of Watermelon, 102
PEALE, A. C., Chemical Society of Washington, 115
Peary's, Lieut., Expedition, GEO. H. BARTON, 308
PECKHAM ADELAIDE WARD, The Colon Group of Bacilli, 981
Peters, Franz, Angewandte Elektrochemie, EDGAR F. SMITH, 588
Petit on the Action of Waters containing dissolved Salts upon Iron, 267
Pfaff, Fr., The Secretion and Composition of Bile, 132; Human Pancreatic Fistula, 910
Philippson, A., Geomorphology, 796
Phillips, W. F. R., Sunstroke Weather of August, 1896, 509
Philosophical Society of Washington, BERNARD R. GREEN, 408
Physical, Vectors, The Blackboard Treatment of, C. BARUS, 171; and Mental Tests, Report of the Committee on, 211; Review, 315, 484 Laboratory, A British National Physical, 397; Education Review, American, 399; G. W. F., 666; Laboratory, A National, at Washington, 511; Laboratory for India, 728
Physicians and Surgeons, The Fourth Session of American, 441, 547, 761
Physics, Recent Text-books on, 805
Physiography, Current Notes on, W. M. DAVIS, 20, 177, 263, 336, 437, 507, 577, 647, 722, 795, 869, 945
Physiological Society, The American, FREDERIC S. LEE, 129, 900
Physiology, Opportunities for Training in, H. P. BOWDITCH, 446
Pickering, E. C., Method of Determining the Relative Motions of Stars in the Line of Sight, 102; Zeta Puppis, 591, 726
Pickering, Spencer, Electrolytic Dissociation of Salts in Solution, 221
Pierce, Jr., Josiah, Projection of Panoramic Views of Contoured Surfaces, 667
PIERCE, ROBERT M., 'Organic Selection,' 844
PILSBRY, H. A., LEWIS WOOLMAN, PHILIP P. CALVERT, Postage on Specimens of Natural History in the International Mails, 402
Plague, 219, 224, 269, 305, 341, 342, 442, 512
Plant Registration, A Proposed Bureau of, 19
Plateau, Félix, How Flowers attract Insects, 689
Platinum, The Production of, in Russia, 651
Play of Animals: The Fur Seal, F. A. LUCAS, 480
Pliocene Man in Britain, 439
Pollard, C. L., A Type in Botany, 487
POOR, CHAS. LANE, Scientific Association of the Johns Hopkins University, 192, 318, 667
Poor, Chas. Lane, Mirror and Equatorial Mounting for Reflecting Telescopes, 668
Porter, W. T., Physiology of the Mammalian Heart, 129; The Heart Beat, 905; Recovery of the Mammalian Heart from Fibrilary Contractions, 905; Beat of the Ventricle and Flow of Blood through the Coronary Arteries, 906
Porro, C., Scientific Geography in Italy, 264
Postage, Rates on Specimens of Natural History in the International Mails, H. A. PILSBRY, LEWIS WOOLMAN, PHILIP P. CALVERT, 402
Potomac Formation, Professor Fontaine and Dr. Newberry on the Age of the, LESTER F. WARD, 411

Potter's Wheel in Ancient America, H. C. MERCER, 919; D. G. BRINTON, 598
Poudré, LUDOVIC ESTES, 805
Pratt, F. H., Vessels of Thebesius, 906
Preuss, K. T., The Meaning of Mourning, 141
Prosser, Chas. S., Carboniferous and Permian of Nebraska and Kansas, 282, 519; and Logan, on the Uplands and Valleys of Kansas, 945
Pseudo Aurora, An Explanation of the so-called, J. PAUL GOODE, 186; H. A. HAZEN, 447.
Psychological, Association, The American, LIVINGSTON FARRAND, 206; Index, 803; Laboratory of University College, London, 874
Psychology, Academy of Sciences, LIVINGSTON FARRAND, 283, 776; and Comparative Psychology, WESLEY MILLS, 718: Experimental at Cambridge, 729; and Anthropology, N. Y.
Purrington, C. W., Telluride Mining District in San Juan Mountains, 890
PUTNAM, F. W., American Association for the Advancement of Science, 760
Putnam, F. W., Early Presence of Man in the Delaware Valley, 196

'Quadrangle,' Use of the, 581
Quaternary of Missouri, J. E. TODD, 695
Quevedo, S. A. L., The Chaco Idioms, 303; The Chaco Tribes, 988

R., E., Anleitung zur mikrochemischen Analyse, H. Behrens, 115
Rambaut, Rate of an Equatorial Clock, 222
Ratzel, Frederick, The State and its Soil, 54
Ravold, Amand, Test for Typhoid Fever, 159
Rees, J. K., Great Shower of Meteors of 1833 and 1866, 70; and Harold Jacoby and Herman S. Davis, Variation of Latitude, 759
Reflection, Total, Newton's Experiment, F. W. MCNAIR, 620
Regnault, A Lecture by, WOLCOTT GIBBS, 409
Reid, Clement, Excavations at Hoxne, 257
REID, HARRY FIELDING, Glaciers of North America, Israel C. Russell, 660
Reid, Harry Fielding, Glaciers, 91, 190, 318, 925
Remsen, Ira, Hydrolysis of Acid Amides, 665; and G. W. Gray, On Isomeric Chlorides of p-Nitro-o-Sulphobenzoic Acid, 962
Renouf, Edward, Metallic Carbids, 192
Research, and the University, 470; Fund, 580
Reubens, H., and E. F. Nichols, Heat Rays of Great Wave-Length, 316
Reymond, Emil Du Bois, S. J. MELTZER, 217
Richards, H. M., Reactions of Plants, 596
Richardson, G. M. and P. Allaire, Specific Gravities of Water Solutions of Formic Acid, 357
Ridgway, Robert, Birds of the Galapagos Archipelago, C. H. M., 770
Ries, Heinrich, Mineralogical Notes, 560
Rifles, Modern Army, 142
Rinderpest, 58, 273, 654, 918, 990
Ripley, W. Z., Racial Geography, 101, 797
Ritchey, G. W., Large Specula, 592
Ritter, W. E., Social Ascidians from California, 434
Roberts, A. W., The Value of Light Ratio, 521
Röntgen Rays, Electrification of Air by, LORD KELVIN, J. G. BEATTIE, M. SMOLUCHOWSKI DE SMOLAN, 139
Rood, Irene E., Papers presented to the World's Congress on Ornithology, C. F. BATCHELDER, 189
ROOSEVELT, THEODORE, A Layman's Views on Scientific Nomenclature, 685; The Discrimination of Species and Sub-Species, 879
Rose, T. K., Extraction of Gold by Chemical Methods, 615
ROTCH, A. LAWRENCE, The International Meteorological and Hydrological Meetings, 17; The Meteorological Conference at Paris, 152; Monument to the late Buys-Ballot, 994
Rotch, A. L., Exploration of the Free Air, 612
Royal, Institution, 340, 729; Society, Election of Members, 873; Conversazione, 875
Rudolph, E., Volcanic Phenomena of 1894, 796
Runge and Paschen, Oxygen in the Sun, 522
RUSBY, H. H., Torrey Botanical Club, 36
Rusby, H. H., Botany at the Pan American Medical Congress, 1896, 36; Solanaceæ, 451
Russell, H. L., Milk Preservation, 408
RUSSELL, ISRAEL, C., A New Geographical Journal, 477
Russell, I. C., Geology of Northeastern Washington, 94; Glaciers of North America, 487; HARRY FIELDING REID, 660: Glacial Ice, 590
Rydberg, P. A., Sand Region of Central Nebraska, 596; Flora of Western Nebraska, 926

Saginaw Valley, The Drainage of the, ALFRED C. LANE, 553
St. Louis, Academy of Science, WM. TRELEASE, 36, 159, 240, 362, 452, 524, 632, 704, 776, 892
Salaries, in the Department of Education, 24; of German University Professors. 59, 307
Salisbury, R. D., Loess on the Wisconsin Drift-formation, 191; Stratified Drift, 191; Baraboo District, Wis., 870, and W. W. Atwood, Drift-Phenomena, 519
Sandplains of Truro, Wellfleet and Eastham, AMADEUS W. GRABAU, 334
Sanitation and Hygiene of Railways, International Congress of, 474
Sapper, Carlos, Geology of Chiapas, Tabasco and the Peninsula of Yucatan, 191; Physical Geography of Yucatan, 724
Sardeson, F. W., Galena and Maquoketa Series, 486
Schaper, H., Nervous System of Vertebrates, 430
Schlegel, G., The Position of Women in China, 393
Schmeltz, J. D. E., Ethnographical Museums, 545
Schmidt, Emil, Systematic Anthropology, 913
Schrenk, H. von, Parasitism of Lichens, 36
SCHUCHERT, CHARLES, What is a Type in Natural History? 636
Schultheiss on Visibility of Mountains and Atmospheric Dust, 613
Schuster, Arthur, Oxygen in the Sun, 628; and Sees, Practical Physics, 805
Schwarz on Two Genera of Beetles, 856
Schweger-Lerchenfeld, A. von, Atlas der Himmelskunde, 837
SCHWEINITZ, E. A. DE, The War with the Microbes, 561
Science, A National Department of, CHAS. W. DABNEY, Jr., 73; WASHINGTONIAN, 147; and Pseudo-science in Medicine, GEORGE M. STERNBERG, 199; in College Entrance Examinations, 399; Teachers' Association, The N. Y. State, FRANKLIN W. BARROWS, 457, 498, 531; S. H, GAGE, 458; E. L. NICHOLS, 464; ALBERT L. AREY, 460; RALPH S. TARR, 498;

R. E. DODGE, 503; THOMAS B. STOWELL, 531; in the Newspapers, 471; Literature and Art, A Bill for the Suppression of, 510; and the Scientific Citizen, The Relation of, to the General Government, J. R. EASTMAN, 525; and Education, The Threatened Legislation against, 546; and Politics, 952; Indiana Teachers' Association, 954
Scientific, Notes and News, 22, 54, 102, 142, 181, 222, 267, 303, 339, 395, 440, 470, 510, 546, 579, 616, 689, 694, 727, 764, 799, 838, 873, 915, 950, 989; Literature, 20, 62, 109, 153, 187, 227, 277, 311, 347, 404, 448, 481, 517, 553, 587, 621, 659, 696, 732, 770, 805, 846, 882, 921, 958, 995; Journals, 33, 69, 157, 190, 228, 281, 315, 356, 406, 484, 519, 589, 628, 664, 701, 738, 773, 852, 888, 925, 961, 998; Association of the Johns Hopkins University, CHAS. LANE POOR, 192, 318; Instruments, Taxon, 582, Exhibits at Tennessee, 689; Books and Apparatus, 730
SCLATER, P. L., On the Distribution of Marine Mammals, 741
Scott, William B., An Introduction to Geology, H. S. WILLIAMS, 659
SCRIBNER, F. LAMSON, Grasses of North America, W. J. Beal, 62
SCRIPTURE, E. W., Law of Size-weight Suggestion, 227
Seal Fur, Investigation, 493; Fisheries, 916
Secretions, Internal, Considered in Relation to Variation and Development, ALBERT MATHEWS, 683; Significance of, WESLEY MILLS, 920; considered from a Chemico-Physiological Standpoint, R. H. CHITTENDEN, 969
See, T. J. J., The Evolution of Stellar Systems, 180; and Cogshall on Double Stars, 303
Semon on the Monotremes, J. H. McG., 643
Sergi, Guiseppi, Antropologia della Stripe Camitica, D. G. BRINTON, 808
Setchell, William A., Laboratory Practice for Beginners in Botany, L. M. UNDERWOOD, 735
SEWALL, HENRY, Electro-Physiology, W. Biedermann, 481
Shaler, N. S., Subterranean Water, 703
Shaw, Albert, Municipal Government in Continental Europe, EDWIN O. JORDAN, 450
Sheldon, S., and M. B, Waterman. The Formation of Lead Sulphate, 31
Shober, W B., and H. E. Kiefer, Asymmetadiazoxylenesulphonic Acid, 853
Siebrecht, Henry A., Orchids, 523
SIMONDS, FREDERIC W., Texas Academy of Science, 116, 363, 488, 703, 812; Gifts to the University of Texas, 444; Marine Fossils from Arkansas, James Perrin Smith, 850
Simpson, Charles T., The Unios, 739
Singer, E. A., Physiology of Sensation, 207
Size-weight Suggestion, Law, of, E. W. SCRIPTURE, 227
Slavery of the American Indians, 948
SMITH, EUGENE A., Alabama Industrial and Scientific Society, 72, 927
SMITH, EDGAR F., Lavoisier Monument, 403; Angewandte Elektrochemie, Franz Peters, 588
Smith, Erwin F., Bacterial Disease of Cruciferous Plants, 963
SMITH, HARLAN I., The American Folk-lore Society, 215
SMITH, JOHN B., Classification of Insects, 671
Smith, James Perrin, Marine Fossils from Arkansas, FREDERIC W. SIMONDS, 850
Smith, W. S. T., Santa Catalina Island, Cal., 648
Smithsonian, Institution and the National Museum, 37; Table at the Naples Station, CH. WARDELL STILES, 659.
Societies and Academies, 34, 70, 115, 158, 192, 230, 283, 317, 359, 408, 451, 487, 523, 557, 592, 629, 667, 702, 739, 774, 810, 855, 889, 925, 963, 999
Söderbaum on Acetylid of Copper, 872
Sonstadt, E., Experiments on Sea Water, 179
Species and Sub-Species, A Method of discriminating between, C. HART MERRIAM, 753; J. A. ALLEN, 877; THEODORE ROOSEVELT, 879
Spelling, Simplified, G. K. GILBERT, 185
Spencer, G. L., Determination of Caffeine, 240
Spencer's Principles of Sociology, FRANKLIN H. GIDDINGS, 732
Sprague, Charles J., Thomas Tracy Bouvé, 72
Spurr, J. E., Measurement of Faults, 238
STANLEY, HIRAM M., Highhole Courtship, 920
Stanton, T. W., and F. H. Knowlton, Stratigraphy and Paleontology of the Laramie, 94
Starr, Frederick, The Shell Gorgets, 265
Steam, High Pressure, The Promise and Potency of, R. H. THURSTON, 573
STEJNEGER, LEONHARD, Das Tierreich, 846
STERNBERG, GEORGE M.; Science and Pseudo-Science in Medicine, 199
STETSON, GEORGE R., The Fauna of Central Borneo, 640
Stetson, George R., The Eye, the Ear and the Common Weal of Whites and Blacks, 35
STEVENSON, J. J., The Story of a Piece of Coal, Edward A. Martin, 810
Stevenson, J. J., Geology of the Bermudas, 239
Stewart, C. C., Preparations of the Nerve Cell under acute Alcoholic Poisoning, 137
Stewart, G. N., Output of the Heart, 137
Stickney, Gardner P., Aboriginal Cultivation of Maize, 913
STILES, CH. WARDELL, The Smithsonian Table at the Naples Station, 659
Stone, W. A., Experimental Physics, 805
Storms, Winter, on the Coast of China, 649
STOWELL, THOMAS B., The Educative Value of the Study of Biology, 531
STRONG, E. A., L'hypothèse des atomes dans la science contemporaine, Arthur Hannequin, 736
Surgery, A Case of Primitive, FRANK HAMILTON CUSHING, 977
Swartz, S. E., on Amide Bromides, 665
SWEZEY, G. D., Neb. Academy of Sciences, 158
Swingle, W. T., Algæ from Gulf of Naples, 236
Sylvester, GEORGE BRUCE HALSTED, 597

T., R. H., Alfred Tresca, 53; Pumping Machinery, J. Weisbach and G. Herrmann, 773
TABER, C. A. M., The Coming Ice Age, 658
Taber, C. A. M., The Coming Ice Age, G. F. WRIGHT, 483
Tabot, H. P., Volatility of Ferric Chloride, 157
TARR, RALPH S., Former Extension of Greenland Glaciers, 344, 515, 804; Place of the Earth Sciences in the Secondary Schools, 498
Tarr, Ralph S., Cornell Glacier, Greenland, 87; Climate of Davis's and Baffin's Bay, 590; Changes of Level in the Bermuda Islands, 854

Tarsius, The Relations of, to the Lemurs and Apes, CHARLES EARLE, 258; A. A. W. HUBRECHT, 550; Further Considerations of the Systematic Position of, CHARLES EARLE, 657
Tassin, Wirt, A New Blowpipe Reagent, 557; Crystal Structure, 774
Tawney, G. A., The Tactual Threshold, 208
Taylor, F. B., The Nipissing-Mattawa River, 90; Moraines, of Recession and their Significance in Glacial Theory, 90.
Teeth of the Mammalia, Origin of the, HENRY F. OSBORN, 576
Teit, James, Origin of Rock Paintings, 141
Telescope of Greenwich Observatory, 727
Telescopic Objectives, On supposed Effects of Strain in, ALVAN G. CLARK, 768
Teller, G. L., Proteid of Wheat, 157
Tellurium, 726
Terrestrial Magnetism, 191, 665
Texas Academy of Science, FREDERIC W. SIMONDS, 116, 363, 488, 703, 812
Thierry, Maurice de, Atmospheric Ozone, 725
Therapeutic Effects of high Frequency Currents, 730
THURSTON, R. H., Étude de huit essais de machine à vapeur, V. Dwelshauvers-Dery, 153; The Apprenticeship Question, 299; The Promise and Potency of High Pressure Steam, 573
Tierreich, Das, LEONHARD STEJNEGER, 846
Tight, W. G., and I. C. White, Preglacial Kanawha, 507
Tilden, W. A., Gases in Crystalline Rocks, 725
Time, The Unification of, 183, 270
Tingle, J. B., Ethylic Oxalata and Camphor, 858
Titchener, E. B., Psychology, JOSEPH JASTROW, 882
TODD, J. E., Volcanic Dust in Southwestern Nebraska, 61; The Quaternary of Missouri, 695; Is the Loess of either Lacustrine or Semi-Marine Origin? 993
Todd, J. E., Quaternary Deposits of Mo., O. H. HERSHEY, 587; Moraines of the Mo. Coteau, 723
Topographical Maps, 305, 869
Torrey Botanical Club, H. H. RUSBY, 36; EDWARD S. BURGESS, 284, 451, 523, 595, 631, 891; N. L. BRITTON, 925
Townsend, C. H., The Alaskan Live Mammoth Story, 319; The Northern Fur Seal, 487
TRELEASE, WM., Academy of Science of St. Louis, 36, 159, 240, 362, 452, 524, 632, 704, 776, 892; The National University, 345
Tresca, Alfred, R. H. T., 53
Trowbridge, John, Electrical Conductivity of the Ether, 730; and T. M. Richards on the Spectra of Argon, 33; Multiple Spectra of Gases, 229; Temperature and Ohmic Resistance of Gases, 590
Tsountas and Manatt on the Ethnography of the Mycenæans, 724
Tubeuf, Karl v., Diseases of Plants induced by Cryptogamic Parasites, G. F. ATKINSON, 596
Tuffts, F. L., on Rood's Flicker Photometer, 452
TURNER, H. W., Nomenclature and Metamorphic Lavas, 226
Turner, H. W., Sierra Nevada 877; Amphibole-pyroxene Rock, 811
Tyler, A. A., Nature and Origin of Stipules, 452
Tylor, E. B., American Games, 22
Type, What is a, in Natural History, CHARLES SCHUCHERT, 636; Specimens, the Re-distribution of, F. A. BATHER, 694; Specimens in Natural History, C. HART MERRIAM, 731
Types, A Postscript to the Terminology of, F. A. BATHER, 843
Typhoon, The 'Iltis,' 649

Ujfalvy, Charles de, Les Aryens au Nord et au Sud de l'Hindou-Kouch, D. G. BRINTON, 60
UNDERWOOD, L. M., Laboratory Practice for Beginners in Botany, William A Setchell, 735
Underwood, L. M., Ferns of Japan, 925
University, and Educational News, 25, 59, 107, 146, 185, 225, 274, 307, 343, 399, 444, 475, 514, 549, 584, 619, 656, 731, 768, 803, 842, 876, 918, 954, 992; A Teaching, for London, 475
Upham, Warren, Topography and Glacial Geology of the City of St. Paul, 487

Van Beneden, and the Origin of the Centrosome—A Correction, EDMUND B. WILSON, 25
Van Hise, C. R., The Deformation of Rocks, 160, 520
Vaughan, T. Wayland, Geologic Notes of Kansas, 558; Eocene Corals, 740; Comanche Series in Oklahoma and Kansas, 999
Velocity of a Flight of Ducks obtained by Triangulation, H. HELM CLAYTON, 26
Venable, F. P., Development of the Periodic Law, W. A. N., 280
VERRILL, A. E., The Florida Monster, 392, 476
Verrill, A. E., Nocturnal Protective Coloration in Mammals, 229, 425; Nocturnal and Diurnal Changes in the Color of Certain Fishes, with Notes on their Sleeping Habits, 427; and K. J. Bush, Genera of Lepidæ and Muculidæ, 34
Vertebrate Embryology, On Certain Problems of, J. BEARD, CHAS. S. MINOT, 107
Vertebrated Animals in the Zoological Gardens of London, FRANK BAKER, 404
Vertebrates from the Kansas Permian, W. S. WILLISTON, 395
Vogel, H. C., Great Refractor of Potsdam Observatory, 591
Volcanic Dust in Southwestern Nebraska, J. E. TODD, 61

W., The Argentaurum Papers, Stephen H. Emmens, 314
Waddell, John, Permeability of Elements of Röntgen Rays, 101
Wait, Charles E., Titanium, 221
Waite, F. C., Brachio and Lumbro-sacral Plexi in Necturus, 436
Waite, M. B., Pear Blight, 668
Walcott, Charles D., Acting Assistant Secretary of the Smithsonian Institution, 222; Inyo Range and Waucobe Lake Beds, Cal., 925
Waldo, Frank, Elementary Meteorology for High Schools, R. DEC. WARD, 312
WARD, LESTER F., Professor Fontaine and Dr. Newberry on the Age of the Potomac Formation, 411
Ward, Lester F., Cycadesidea, 487
WARD, R. DEC, Clouds over a Fire, 60; Current Notes on Meteorology, 219, 264, 337, 468, 508, 612, 649, 837; Elementary Meteorology for High Schools, Frank Waldo, 312; Meteorological Reprints, 339, 661

WARREN, JOSEPH W., Elementary Human Physiology, J. G. M'Kendrick, 809
Warren, J. W., A Search for Pexin, 903
Warren, H. N., Calcium Carbide, 180
Washington, Henry S., Petrological Sketches, 282, 925; The Rocca Monfino Region, 701
WASHINGTONIAN, A National Department of Science, 147
WATASÉ, S., Microsomes and Centrosome, 230
Water Hares, A new Subgeneric Name for the, EDGAR A. MEARNS, 393
Wateville, P. de, Growing Crystals, 651
Watson, Thomas L., Elevation of the Southern Coast of Baffin Land, 282
WATTS, W. W., Geology at the British Association, 252
WAUGH, F. A., Phases in Weed Evolution, 789
Weather Maps, Chalk-plate, 337
Webster, A. G., Constant Angular Velocity, 738
Weed Evolution, Phases on, F. A. WAUGH, 789
Weed and Pirsson on the Bearpaw Mountains, 577
Weed, W. H., Laccoliths in Folded Strata, 811
WELCH, WILLIAM H., Adaptation in Pathological Processes, 813
Weller, Stuart, Batesville Sandstone of Ark., 560
WHEELER, BENJ. IDE., The Smithsonian Institution and a National University, 881
Wheeler, H. A., Clay Deposits of Missouri, H. FOSTER BAIN, 852.
Wheeler, H. L., and P. T. Walden, The Action of Acid Clorides on the Imido-Esters and Isoanilides, 357; and H. F. Metcalf, Chlorcarbonic Ethyl Ester and Formanilide, 521; and B. W. McFarland, Metabrombenzoic Acid, 853; Methenylphenylparatolylamidenes, 853
Wheeler, W. M., Fauna of San Diego Bay, Cal., 775
White, David, Type Specimens in Paleontology, 237
White, I. C., Oil Wells, 93
Whiting, Henry L., M., 300
Whitman, C. O., The Centrosome Problem, 235
WIDMANN, O., Origin of Parasitism in the Cowbird, 176
WIECHMANN, FERDINAND G., The Elements of Electro Chemistry, Max Le Blanc, 32
Wiechmann, Ferdinand G., Lecture Notes on Theoretical Chemistry, JAS. LEWIS HOWE, 313
Wienland and Lauenstein on Oxygen and Fluorin Atoms in Salts?
Wiesbach, J., and G. Herrmann, Mechanics of Pumping Machinery, R. H. T., 773
WILDER, BURT G., The Metric System, 587
Wilder, Burt G., Neural Terms, 358
Wiley, H. W., Influence of Vegetable Mold on the Nitrogenous Content of Oats, 855; and W. D. Bigelow, Bomb Calorimeter, 855
WILLIAMS, JR., E. H., Greenland Glaciers, 448
WILLIAMS, H. S., An Introduction to Geology, William B. Scott, 659
Williams, H. S., Devonian Formations, 92, 738
Willis, Bailey, Glaciation of Puget Sound 238
WILLISTON, W. S., Vertebrates from the Kansas Permian, 395
Willoughby, C. C., Primitive Symbolic Decoration, 835
Will Power, Certain Beliefs concerning, among the Siouan Tribes, ALICE C. FLETCHER, 331
Wilsing on Astronomical Objectives, 303
WILSON, EDMUND B., Van Beneden and the Origin of the Centrosome, A Correction, 25
Wilson, Edmund B., The Cell in Development and Inheritance, C. B. DAVENPORT, 112; Centrosome and Middle-piece in the Fertilization of the Egg, 390
Wilson, Thomas, Pithecanthropus erectus, 194; A Cañon in Prehistoric Archæology, 594; The Swastika, D. G. BRINTON, 960
Wilson, W. E., and G. F. Fitzgerald, Temperature of the Center of an Electric Arc, 591
WINCHELL, N. H., Geological and Natural History Survey of Minnesota, C. E. Beecher, 449
Winkler, Clemens, The Discovery of New Elements during the last Twenty-five Years, 439
Wisconsin University, Science Club, WM. S. MARSHALL, 160, 408, 523, 632
Witmer, L., Practical Work in Psychology, 210
Wolf, J. E., White Limestone of Sussex Co., 96; Tourmalines, 891
WOOD, R. W., Diffraction of X-rays obtained by a New Form of Cathode Discharge, 585
WOODMAN, DURAND, N. Y. Section of the American Chemical Society, 71, 239, 360, 487, 740
Woodman, Durand, Commercial Red Lead, 240
WOODWORTH, J. B., 'Gibbers,' 476; Rocks, Rock-Weathering and Soils, George P. Merrill, 995
Woodworth, J. B., Homology of Joints and Artificial Fractions, 84; Unconformities in Martha's Vineyard and Block Island, 86
WOODWORTH, W. McM., Cambridge Natural History, 938
Wooton, E. O. Plants of New Mexico, 596
Wortman, J. L., Ganodonta, 71
Wright, A. W., Röntgen Rays, 759
WRIGHT, G. F., The Coming Ice Age, C. A. M. Taber, 483; Archæological Discoveries made in the Gravels at Trenton, 586
Wright, G. F., Preglacial Erosion, 196
Wundt, W., Psychology, JOSEPH JASTROW, 882

X-Rays, An Induction Coil Method for, CHARLES L. NORTON and RALPH R. LAWRENCE, 496; Diffraction of, R. W. WOOD, 585; The Effect of the Density of the Surrounding Gas on the Discharge of Electrified Metals by the, C. D. CHILD, 791

YOUNG, C. A., Argentaurum Papers, 343
Young, C. A., 'Reversing Layer,' 268

Zeeman, P., on the Spectrum of a Flame, 764
Zelbr, Karl, Planet and Comet Orbits, 102
Zittel on the Age of Man, 339
ZIWET, ALEXANDER, Higher Mathematics, 277
Zoological, Notes, 175, 302, 392, 543, 577, 762; Club of the University of Chicago, 230, 592, 629, 775, 1000; Society of Germany, 616; Station at Naples, 729; S. E. MEEK, 832; Society of London, 766, 834; Bulletin, 951; Society of New York, 396, 472, 547, 652

SCIENCE

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FRIDAY, JANUARY 1, 1897.

CONTENTS:

The Geology of Government Explorations: S. F. EMMONS..... 1

Phases in Jamaican Natural History: ROBT. B. HILL..... 15

The International Meteorological and Hydrological Meetings: A. LAWRENCE ROTCH..... 17

A Proposed Bureau of Plant Registration..... 19

Current Notes on Physiography:—

Physical Features of Missouri; The Glaciers of Norway; Landslips in Switzerland; Heilprin's Earth and its Story: W. M. DAVIS..... 20

Current Notes on Anthropology:—

American Games as Evidence of Asiatic Intercourse; Racial Studies in Switzerland: D. G. BRINTON.. 22

Scientific Notes and News..... 22

University and Educational News..... 25

Discussion and Correspondence:—

Van Beneden and the Origin of the Centrosome—A Correction: E. B. WILSON. *The Velocity of a Flight of Ducks obtained by Triangulation:* H. HELM CLAYTON. *A Test of Diversity of Opinion:* JOSEPH JASTROW..... 25

Scientific Literature:—

Lydekker's Geographical History of Mammals: C. HART MERRIAM. *Le Blanc's Elements of Electrochemistry:* FERDINAND G. WIECHMANN..... 26

Scientific Journals:—

The American Journal of Science..... 33

Societies and Academies:—

Boston Society of Natural History: SAMUEL HENSHAW. *Anthropological Society of Washington:* J. H. MCCORMICK. *The Torrey Botanical Club:* H. H. RUSBY. *The Academy of Science of St. Louis:* WM. TRELEASE..... 34

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*THE GEOLOGY OF GOVERNMENT EXPLORATIONS.**

I HAVE chosen for the subject of my address this evening the development of our knowledge of the geology of the great West through the agency of explorations and surveys conducted under government auspices.

To the older of our members, especially to those who took part in those early explorations, the matter may appear somewhat trite, but to the younger ones, whose geological memory does not go back beyond the present Survey, I have thought that it might be interesting to listen to a brief account of the origin and methods of work of these earlier organizations by one who was first connected with them very nearly thirty years ago.

The period to be considered commences about with the opening of the century, and is most naturally subdivided by the Civil War. But in this field, as in others, the accumulation of knowledge progresses with ever increasing rapidity, so that, while for the first and much longer sub-period it is possible to trace approximately the actual gains that were made in geological knowledge, in the second period it is only practicable to attempt to characterize and contrast the methods by which geological in-

* Address of the Retiring President of the Geological Society of Washington, delivered Wednesday, December 16, 1896.

vestigation was carried on. The first may be called the period of geographical exploration; the second that of geological exploration.

GEOGRAPHICAL EXPLORATIONS.

It was Jefferson's purchase of the Louisiana territory, in 1803, that gave to the United States government the first title to the Rocky Mountain region, but even prior to that time it appears that he had formed a project for its exploration. He tells us that in 1786, during his residence at Paris (as U. S. Minister) he met John Ledyard, of Connecticut, a companion of Captain Cook on his last voyage to the Pacific Ocean, who had just failed in the attempt to organize a mercantile company to engage in the fur trade on the western coast of America. Jefferson proposed to him 'to go by land to Kamchatka, cross in some of the Russian vessels to Nootka Sound, fall down into the latitude of the Missouri, and penetrate to and through that to the United States.' Ledyard eagerly embraced the idea, and after the permission to pass through her territory had been secured through Jefferson's influence, from the Empress of Russia, with an assurance of protection on his journey, he set forth from Paris and, proceeding via. St. Petersburg, had progressed to within 200 miles of Kamchatka, where he was obliged to go into winter quarters. When he was preparing to resume his journey in the spring he was arrested by an officer of the Empress (who by this time had changed her mind), put into a close carriage and conveyed, day and night without stopping, to the frontier of Poland. He returned to Paris much broken down in bodily health, and not long after (November 15, 1788) died at Cairo, Egypt, whither he had gone for the purpose of exploring the interior of Africa. Thus failed the first attempt at exploration.

1792. In 1792 Jefferson proposed to the American Philosophical Society at Philadelphia 'to set on foot a subscription to engage some competent person to explore that region in the opposite direction; that is by ascending the Missouri, crossing the Stony mountains, and descending the nearest river to the Pacific.' Capt. Meriwether Lewis, a connection by marriage of Gen. Washington, who was then stationed at Charlottesville, Va., on recruiting service, secured the appointment, and was to have had as sole companion the eminent French botanist, André Michaux, but when the latter had reached Kentucky he was recalled by the French Minister, then at Philadelphia, 'and thus failed the second attempt for exploring that region.'

1803. In 1803, two years after Jefferson had become President, in accordance with the suggestions contained in a confidential message from him, Congress so modified a pending act establishing trading houses with the Indian tribes as to extend its provisions to the Indians on the Missouri, and to authorize an exploration of the source of that river and of the best water communication from there to the Pacific, voting $2,500 for the expenses of the expedition.

Jefferson appointed to the command of this expedition Captain Meriwether Lewis, of whose special qualifications for this position he had had abundant proof during the preceding two years, during which he had served as his private secretary.

Lewis repaired at once to Philadelphia 'and placed himself under the tutorage of the distinguished professors of that place,' that he might be prepared to make the necessary scientific observations during his trip. At Lewis' suggestion Wm. Clark was associated with him in the direction, and for that purpose given a commission of captain in the army. Jefferson's detailed instructions of April, 1803, to guide his conduct after leaving the United States (the cession of Louisiana by France had not yet been

completed) afford a valuable insight into the conditions existing at that time, but time will not admit of any considerable quotation from them. He is to inform himself about the Rio Bravo, which flows into the Gulf of Mexico, and the Rio Colorado, which runs into the Gulf of California, which are 'understood to be the principal streams heading opposite to the Missouri and running southwardly.' Among the objects worthy of notice are mentioned: 'the remains and accounts of any animals which may be deemed rare or extinct; the mineral productions of every kind, but more particularly metals, limestone, pit-coal and saltpetre; salines and mineral waters, noting the temperature of the last and such circumstances as may indicate their character; volcanic appearances; climate,' etc.

Lewis left Washington on July 5, 1803, and did not reach there on his return until the middle of February, 1807. Meanwhile, after spending the winter of 1804–5 at the Mandan villages, in a bend of the Missouri about 40 miles above the present crossing of the N. P. R. R., at Bismarck, they had made a most successful trip across the mountains to the mouth of the Columbia river and back, an account of which is set forth in the admirable narrative first published in 1814 and recently republished with notes by Dr. Elliott Coues. This narrative shows a most intelligent observation of natural phenomena and makes mention of the existence of stone-coal along the upper Missouri river.

Schoolcraft's account of his visit in 1818 to St. Louis, then a city of 5,000 inhabitants, describes a museum established by Clark (then Governor of the Territory) containing a collection from his trip to the Rocky Mountains, including 'minerals, fossils, bones and other rare and interesting specimens,' and Nicollet in 1839 speaks of Cretaceous fossils brought in by Lewis and Clark from the upper Missouri river.

1805–7. Scarcely less remarkable were the explorations of Lieut. Zebulon M. Pike to the sources of the Mississippi in 1805, and in 1806–7 to the headwaters of the Arkansas, on the latter of which he made an unsuccessful attempt to climb the peak which has since born his name, and was finally taken from Santa Fé to Chihuahua as prisoner by the Mexican authorities.

Pike's expeditions were conducted under orders of Gen. Wilkinson, and were essentially military in their nature. A surgeon, Dr. Robinson accompanied them, but neither he nor Lieut. Pike have left any record of scientific observations in the narrative which was published in 1810.

1812. The war of 1812 now diverted the attention of government officials from Western explorations, but with the close of this war, when the treaty of Ghent had relieved the frontiers from the sanguinary Indian wars from which the people had been suffering, the prospect of a renewed emigration westward revived interest in exploration.

1820. J. C. Calhoun, Secretary of War under Monroe, a man of great intellectual grasp and energy of character, encouraged every means of acquiring a knowledge of the geography of the West. Two expeditions were organized under his orders in the year 1820, that of Maj. J. H. Long to the Rocky Mountains, and that of Gen. Lewis Cass along the south shore of Lake Superior to the sources of the Mississippi river.

To the former was attached Dr. Edwin James as botanist and geologist, who wrote the narative of the expedition, together with a report on the geological character of the country, which was published in 1823.

To Gen. Cass' expedition, an important part of whose object was to investigate the deposits of copper, lead and gypsum supposed to exist in the Northwest, a mineralogist was appointed in the person of H. R. Schoolcraft, a native of Albany Co., N. Y.,

who had distinguished himself by his investigations of the lead mines of Missouri.

GEOLOGY.

1820. Edwin James, who made the first geological report of a Western expedition, was a pupil of Amos Eaton. It was not until 1832 that Eaton adopted the system of identifying and correlating rock formations by means of their contained fossils. At the time of James' explorations geologists only attempted to distinguish rocks by their external lithological characters as belonging to one of the general great divisions of *primitive*, *transition*, *secondary* and *alluvions*, or recent deposits. Although James was evidently a shrewd observer, one would obtain but a confused idea of the structure of the country from his notes. Nevertheless he was one of the first, as Walcott remarks (Correlation Papers, Cambrian, p. 396) to attempt an extended correlation of geological formations of North America. He observed the general succession of rocks in the Appalachian, Ozark and Rocky Mountains, respectively, finding granites at the base in either case, and tracing the Carboniferous limestones through the two former.

He considered the red sandstones of the Appalachian and Lake Superior regions and of the Rocky Mountains to be of the same age and to probably correspond to the *old red sandstone* of Werner. He was the first white man to ascend Pike's Peak, and the ascent which was made from Manitou Springs, was by no means as easy as at the present day. He and his companion passed the night part way up the slope, where the ground was so steep that they had to prop themselves up by poles between two trees to keep from rolling down as they slept. James suggested the probable existence of artesian waters under the Great Plains, then called the Great American Desert. The material that Schoolcraft discovered in 1819 near Cape Girardeau, on the Mississippi River, and thought to represent the Chalk formation of Europe he found did not effervesce with acid, and classed it as a *native Argil*.

Schoolcraft, whose first government observations were made in the same year, devoted himself more particularly to the economic resources of the country. Already in 1818 he had spent three months in examining the lead mines in Missouri, and had extended his observations beyond the settlements into the Ozark Mountains. Determined to call the attention of the government to the value of its mines, he returned to New York via. New Orleans, and there published his book on the lead mines, which brought him to the attention of Mr. Calhoun, then Secretary of War, and resulted in his commission with the expedition of General Cass. His observations upon geology appear somewhat primitive and quaint, but are characterized by a shrewd common sense, as will be shown by a few quotations.

In speaking of the red sandstone on the south shore of Lake Superior near Grand Island, he says "the sandstone laps upon the granite and fits into its irregular indentations in a manner that shows it to have assumed that position subsequently to the upheaving of the country. Its horizontality is perfectly preserved even to the immediate point of contact. A mutual decomposition for a couple of inches into each rock has taken place. As to the geological age of the sandstone I possess no means of forming a decisive opinion. It consists of grains of quartz or sand united by a calcareous cement and colored by the red oxide of iron. In some places it imbeds pebbles of quartz of the size of a pigeon's egg, together with rounded masses of hornblende and other rocks, and it then resembles a pudding stone. It has no imbedded relics of the animal or vegetable kingdom so far

as observed, but this is not always conclusive of the age of the rock viewed at a given point, for it is known that these relics are never uniformly distributed throughout the substance of the rocks, even of the newest formations. Its position would indicate a near alliance to the old red sandstone. Werner has considered this rock in all situations as secondary. Bakewell places it in a class of transition rocks, in which he is followed by Maclure and Eaton. I am not prepared to decide upon the point * * *, and shall content myself in the present instance with a bare recital of the facts."

After the examination of the famous mass of native copper, variously estimated to weigh from one to five tons, which was the attraction of all travelers to the Lake Superior region, he says, in the course of his reflections upon its probable manner of occurrence, "there is reason to presume that the precious metals may be found in the northern regions of the American continent. Nothing appears more improbable than that the veins of silver ore that are so abundant in Mexico and the province of Texas are checked in their progress northward into Arkansas and Missouri by the effect of climate. This metal is known to be found in association only with certain limestones, schists and other rocks, and when these cease it is in vain to be sought. Other metals and minerals have their particular associations serving as a geognostic matrix, and hence rock strata may be considered as indexes to particular metals, minerals and ores, and the geologist is thus enabled to predict with considerable certainty from an examination of the exterior of the country whether it is metalliferous or not." In his 'Lead Mines of Missouri' he had mentioned the occurrence of chalk with flints, at Little Chain of Rocks, on the Mississippi River, which he says was worked commercially and found equal to foreign chalk. This was probably a bed of white pipe clay described by Shumard in 1871 (Missouri Geological Survey). He mentions the fluorspar of southern Illinois, the novaculite of the Arkansas Hot Springs, the red pipe stone of the upper Mississippi, coal in western Pennsylvania, Ohio, Virginia, Kentucky, Illinois and Missouri; also hydrogen gas or carburetted hydrogen at the Burning Spring on the Licking River. Pumice, he says, is brought down the Missouri River in the June floods, and probably comes from some volcanic mountain at the head of the river. A pseudo-pumice is also brought down which he supposes to have originated from the burning of beds of coal. He speaks of a mass of native iron, upwards of 3,000 pounds in weight, discovered on the banks of the Red River, and now (1819) in the collection of the New York Historical Society. "Its shape is irregular, inclining to oval form, its surface deeply indented and covered with oxide of iron. It is said to contain nickel, etc,"

1821. In 1821 Schoolcraft made another expedition with General Cass from Toledo across Ohio and Indiana, past the fluorspar deposits of southern Illinois, to St. Louis, returning by way of Chicago, an account of which was published as 'Travels in the Central Portions of the Mississippi Valley.'

1823. In 1823 a second expedition under Major Long was sent out by the War Department, which followed the Mississippi and Red River of the North to Lake Winnipeg, returning along the northern shore of Lake Superior. To this expedition Prof. William H. Keating, of Philadelphia, was attached as geologist, and published a narrative in two volumes in 1823 (George B. Whittaker, London). Keating in his narrative of the expedition, which started at Philadelphia, notes the evidences of old copper mining at South Mountain, in Maryland; the fact that coal mining is being

carried on at Cumberland, and at various points between there and Wheeling. He also remarks upon the Blowing Springs, and said he had no opportunity of testing whether they sent out gas or only air. He frequently mentions fossils observed, *encrinites* and *productus*, but does not attempt to define geological horizons by them, but only to judge whether the limestones were primitive (without organic life), transition or secondary.

1832. In 1832 Mr. Schoolcraft, under a commission from the government, commanded an expedition to the country about the sources of the Mississippi River, which he discovered took its rise in Lake Itasca, a narrative of which was published in 1834, and again enlarged in 1855.

1832–6. The expeditions of Capt. Bonneville, U. S. A., made famous by Irving's two narratives, were not, strictly speaking, government expeditions, being conducted under the auspices of the American Fur Trading Company, while he was on leave of absence from the army. No geologist was attached to the expedition, but the geographical results were very important, as by them was first determined the enclosed nature of the great interior basin, which had hitherto been supposed to have an outlet to the Pacific Ocean through the mythical Rio Buenaventura.

1834–5. G. W. Featherstonaugh, of whose origin little seems to be known except that he was a foreign traveler, was employed by Lewis Cass as Secretary of War, during the years 1834–5, to make geological investigations in the Ozark Mountains and along the elevated plateau separating the Missouri River from the St. Peter, or Minnesota River, known as the Coteau des Prairies. The report upon the first of these regions was published in 1835, and that upon the second in 1836.

In Featherstonaugh's time, light was commencing to come to the minds of American geologists out of the obscurity of ideas concerning the existing division of rocks into primitive, transition and secondary. It was already practically recognized that different horizons could be correlated in different parts of the world more safely and accurately by fossils than by lithological characters. Featherstonaugh found Carboniferous fossils widespread throughout the United States, on which he makes the following comments: "Although these fossils are not identically the same as their equivalents in Europe, yet many of them are strictly so; and in all cases I would assert the generic resemblances to be stronger than the specific differences. On this continent, where the Carboniferous limestones extend uninterruptedly for more than 1,000 miles, we find an equal amount of generic resemblance and specific difference, and it is certain that the specific difference between the most powerful species of living animals here and those in trans-Atlantic countries seems to be much greater than that which prevails among fossils of the two hemispheres." With regard to what had been generally known as primitive or inorganic rocks, however, he is not willing to accept the Wernerian or Plutonic theory of origin. Their differences with each other, except statuary marble, he remarks, result only from a difference in proportions of certain mineral constituents, which gives rise to the opinion that they had a common origin and "that they have all at some period been either ejected from central beds by the expansive power generated there, or that they have been great intumescing masses which on cooling have resolved themselves into various stages of crystallization, and that their varying products have been brought by fusion or solution into distinct central localities."

In his report Featherstonaugh publishes a section 12 feet long, extending from the Atlantic Ocean to Texas, which presents a

remarkably truthful representation, for the times, of the broader features of Appalachian structure. He calls attention to the fact that the littoral line on the Atlantic face of the mountains is found near the falls of the rivers. In his second report he gives a columnar section showing the correspondence of American and European formations, with average thickness of the latter, in which the Upper Cretaceous, Wealden, Oolite, and possibly the New Red sandstones are said to be deficient in the United States. In this section the Cambrian forms the base of the organic division. He remarks upon the rapid progress which geology has made in Europe during the past thirty years, and the increased interest manifested in this country as the result of his first report, giving rise to a movement among the States to undertake geological surveys. He says: "A geological map of the whole United States, where all the formations are exhibited on a large scale, and the most important deposits of fuel, metals and useful minerals be accurately laid down, would be a monument both useful and honorable to the country at home and abroad, and I trust the day is not distant when Congress will direct such a map to be constructed upon a scale commensurate with the undertaking."

1838. In 1838 J. N. Nicollet, a Savoyard naturalist, who had spent the last five years studying, at his own expense, the physical geography of the Southern and Mississippi Valley States, was commissioned by Col. Abert, of the Topographical Engineers, to make a map of the hydrographic basin of the Mississippi River.

In his report Nicollet remarks on the universal distribution of drift material, even on the summit of the Coteau, which had hitherto been called alluvium, but for which he prefers the term *Erratic deposites*. His principle contribution was the recognition of the fact that in that region there were limestones lower than the Carboniferous represented by fossils. He thought to have the Devonion in the lower part of the Mountain limestone, and he obtained Trenton fossils from the limestone around the Falls of St. Anthony. He also discovered the Cretaceous above Council Bluffs, and recognized its importance 'as destined to occupy a conspicuous place in the history of American geology.' Fort Pierre Chouteau was the upper limit of his explorations on the Missouri River. He got authentic accounts of pseudo-volcanoes caused by the spontaneous combustion of bituminous material within the rocks higher up the river, which he thinks may account for some, at least, of the pumice-like material that floats down the Missouri River.

1839. An important epoch in the study of western geology is marked by the work conducted under David Dale Owen, from 1839 to 1854. Dr. Owen was the son of Robert Owen, the social reformer, and at the same time a well-to-do manufacturer, who had settled in New Harmony, Ind., to carry out practically some of his social theories. David had received a liberal education abroad, both in Switzerland and Scotland, and had spent a year in London studying geology, in companionship with Henry B. Rogers. He later took the degree of M. D. in the Ohio Medical College in 1836. Having been appointed State Geologist of Indiana, he made a preliminary reconnaissance in 1837–8. The then Governor, James Whitcomb, became later United States Land Commissioner, and appointed Owen to make a survey of the Dubuque and Mineral Point land districts in Wisconsin and Iowa, under authority from Congress, in order to enable him to reserve from sale those sections containing mineral wealth. This work had to be done promptly, and it was commenced in September, 1839, and completed in February, 1840. He had 139 sub-agents and assistants under him, examining each sec-

tion under his instruction and supervision. Dr. John Locke was his geological assistant in this work. The determination of fossils of geological horizons was yet very imperfect, and the main conclusion arrived at was that the lead-bearing limestones were probably older than the Carboniferous.

1841. In 1841 the Wilkes Exploring Expedition, which, since 1838, had been cruising along the coasts and among the islands of the Pacific ocean, reached the coast of Oregon. Near the mouth of the Columbia river the ship Peacock on which was Prof. James D. Dana, the geologist of the Expedition, was wrecked, entailing the loss of all the latter's personal effects as well as many of his collections.

His loss was in the end, however, a gain to geological science, for on his trip across the Cascade mountains, and to San Francisco through the mountains of Oregon, past Mt. Shasta and down the valley of the Sacramento, he gained a personal knowledge of the geological conditions of the West, which was invaluable to him in later years when he was called upon to discuss the observations of later observers in the preparation of his Manual of Geology.

In his report upon the geology of the Wilkes Expedition, Dana calls attention to the fact that the slates of the Umpqua and Shasta regions resemble gold-bearing rocks of other regions, but it does not appear that he found actual evidence of the occurrence of gold.

He did observe the occurrence of sandstone dikes intersecting sandstones and shales near Astoria, and drew some interesting conclusions as to changes of level of the Coast region, which were further evidenced by the fiords along the coast and terraces along the river valleys; the latter he reasoned could not be explained by the current hypothesis that they were deposited in barrier lakes. As regards the whole Rocky Mountain region he concludes that it was probably in a great measure submerged until Cretaceous or later time.

1842–5. The three famous expeditions of Fremont were conducted in the years 1842, 1843–4 and 1845 respectively. They covered a very large part of the Cordilleran region, but unfortunately no geologist was attached to the expedition. Fremont himself, however, was a scientifically educated man, and had served under Nicollet in his expedition up the Missouri. His scientific notes, and the fossils and rocks collected, were afterwards worked up by Prof. James Hall.

Among the specimens thus brought and described were detected Niobrara limestones, upturned against the granites near Pike's Peak; green clays from the Eocene of the Bridger Basin, thought to resemble Cretaceous green sand; coal from the Muddy on the western edge of that basin, with fossil ferns which Hall said were not Carboniferous; fresh water shells from the Tertiary formations there and at the head of the Uinta River, on the east slope of the Wasatch Mountains; various eruptive rocks from the Snake River Valley, Blue Mountains and the Cascade Range; and a series of specimens from a bluff 700 feet high, which consisted largely of volcanic ash with fresh water fossil infusoria, which were probably formed of the Tertiary beds of the John Day River.

1846. In the spring of 1846 Dr. Wislizenus, 'a German by birth, but an American by choice,' as he characterizes himself, and evidently a man of wide scientific culture, undertook an examination into the geography and natural history of northern Mexico and Upper California at his private expense. While on his way west the war between the United States and Mexico broke out, and he was detained a prisoner for six months in the state of Chihuahua. Finding it impracticable to continue his work unaided, upon the arrival of the

American troops, he accepted the position of surgeon in the United States army, and finally returned with Col. Doniphan's command. His narrative, with scientific appendices, was printed by order of Congress. In it he notes Cretaceous rocks on the Great Plains, Cretaceous limestones with *Inoceramus* near Las Vegas, and the sandstones near Santa Fé 'thrown back at an angle of 100 degrees by the uplift of the granite.' Silurian limestones were seen near El Paso, and both Silurian and Cretaceous limestones around Chihuahua, Mexico. He does not appear, however, to have met with any outcrop of coal-bearing rocks. He remarks on a decadence of mining in Mexico and gives interesting statistics on the ancient silver and copper mines in the State of Chihuahua. In his report he gives what is called a geological map of the regions traversed, in which the occurrence of rocks of the different descriptions are indicated by words.

1847. In 1847 under the auspices of the United States Land office, of which James Whitcomb had now become Commissioner, David Dale Owen commenced his final survey of the Northwest Territory comprising parts of Wisconsin, Iowa, Minnesota and Nebraska. Although this work only incidentally extended into the region west of the Mississippi valley, it forms an important epoch in the geological history of the West, for it was the first systematically organized geological survey conducted under government authority, and by finally establishing geological horizons it has formed the basis of all later geological work in this region.

Dr. Owen had a large corps of scientific assistants and through them left a strong impress upon geological work in the Mississippi Valley. Among them were Richard Owen and E. T. Cox, who worked later in Indiana, A. H. Worthen in Illinois, Chas. Whittlesey at Lake Superior and J. G. Norwood in Kentucky.

After five years of field and one of office work, the report was published in two quarto volumes, with a large colored geological map, and a memoir on vertebrates by Dr. Joseph Leidy.

1847–1850. In this connection a brief mention may be made of the survey of the Lake Superior region, generally known as the Foster and Whitney Survey, because, although not carried on in the region under consideration, it had indirectly considerable influence on Western surveys.

Congress in March, 1847, had passed a law governing the sale of mineral lands in the Lake Superior land district which provided that the Secretary of the Treasury should cause a geological survey to be made previous to the offering of the lands for sale.

Dr. Chas. T. Jackson was appointed in the spring of 1847 to execute the survey, but resigned after two seasons' work, and the completion of the work was confided to J. W. Foster and J. D. Whitney, whose final reports were submitted in 1850 and 1851. They were assisted in their geological work by S. W. Hill and Edward Desor, the later an eminent Swiss geologist who had come to this country with Agassiz; while James Hall reported on their fossils and made valuable geological contributions to their final report. Whitney was not again in government employ, but played an important part in the development of its mineral resources, by his volume on the Metallic Wealth of the United States published in 1854, in which the theoretical views on ore deposits were far in advance of any published in this country or Europe, and which for many years was the only scientific treatise on the metallic mineral wealth of the country. He subsequently (1859–60) served on the Geological Survey of Wisconsin, making a special study of its lead mines, and in 1860 organized the State Geological Survey of California.

1849. In 1849 Dr. John Evans, under the

instruction of his chief, D. D. Owen, ascended the White River to the Bad Lands of Nebraska, along the southeast base of the Black Hills, and made collections of fossil vertebrates in the White River Miocene, whose existence had first been brought to notice through specimens sent in by the parties connected with the American Fur Trading Company. He also collected Mollusca in the Cretaceous beds from Fort Pierre up to a point 300 miles below the mouth of the Yellowstone, and traced the great lignite coal formation from there nearly to the Yellowstone River. The collections made at this time by Dr. Evans, together with those collected under the auspices of the Smithsonian in 1850 by T. A. Culbertson, and by Gen. Stuart Van Vliet of the United States army, were described in the Smithson contributions by Dr. Leidy in 1852. In this famous memoir the since well known forms *Titanotherium* and *Oreodon* were first described, and the age of the beds in which they occurred given as Eocene Tertiary.

1849-50. In 1849-50, under the orders of Col. Abert, of the Topographical Engineers, Lieut. Howard Stansbury made a survey of Great Salt Lake, and explored its valley and the surrounding mountains. No geologist was attached to his party, but his notes and fossils were reported upon by Prof. James Hall.

Stansbury noted the widespread occurrence of coal beds and recognized their future industrial importance, but does not appear to have obtained any data to determine their age. He brought in fossils from the Carboniferous limestone in Kansas, in Wyoming near Fort Laramie, and around Salt Lake Basin.

1851–52. In the summer of 1852 Captain R. B. Marcy and Brevet Captain George B. McClellan, of the United States Engineers, made an exploration in the Red River country from Fort Smith, Ark., to Fort Belknap, on the Brazos River, Texas. Dr. G. G. Shumard was appointed surgeon and naturalist to the expedition, and made collections which were submitted to various specialists for examination and study. Their reports are contained as appendices in Captain Marcy's report, published by act of Congress.

Hitchcock, the elder, reported on the specimens collected, except the fossils which were submitted to the latter's brother, Dr. B. F. Shumard, for identification. Carboniferous and Cretaceous forms were definitely determined, but Hitchcock was somewhat in doubt, owing to the imperfection of his data, whether the coals of the Brazos River were correctly assigned to the Carboniferous, on account of the loose texture of the rocks, and the fact that lignites of Tertiary and Cretaceous age were known to exist further north. The doubt is a reasonable one, for these coal beds are at the present day the most western workable coals of Carboniferous age known on the continent. Hitchcock remarks on the evidence shown in the canyons of the Llano Estacado, of the power of erosion, and shows that it was not necessary to resort, as Marcy was inclined to do, to the shattering of the crust by some great dynamic force to account for them.

In 1853 were commenced the numerous expeditions under the War Department to explore a route for a transcontinental railroad from the Mississippi Valley to the Pacific Ocean. To most of these parties a geologist or naturalist was attached, and the results of their observations, together with those of other naturalists, are found in the thirteen quarto volumes of the Pacific Railroad reports. They include Marcou, Newberry, Evans, Blake, Antisell, Gibbs and Schiel.

1853–4. Two reports made by Dr. John Evans to Gov. Stevens upon the geology of the northern route were lost in transit from the field to Washington. Dr. Evans died

at Washington in 1861 while at work upon his final report upon this region, which has consequently never been published.

To the expedition which explored the middle route across Colorado and Utah in 1853, under Capt. Gunnison, who was killed by Indians in Sevier Lake Valley, and through Wyoming, Utah and Nevada to California, in 1854, under Lieut. Beckwith, Dr. James Schiel was attached as surgeon and geologist. His report and Beckwith's narration contain scattered notes on the geology of the route, but no connected description.

Jules Marcou, who had come to this country from Switzerland with Agassiz, was the first geologist to study Western rock formations, who had had a field training in Europe. While his personal familiarity with different geological horizons in Europe enhanced the value of his field determinations, it also exposed him to the danger of laying too much stress in correlation upon mere physical resemblance. The route of the Whipple expedition, to which he was attached as geologist in 1853–4, followed the Arkansas and Canadian rivers from the mouth of the former to the source of the latter, and thence through New Mexico to Albuquerque; it then followed in a general way the general route of the Atlantic and Pacific Railroad to Los Angeles. His preliminary report was published in 1855. He also prepared a diagramatic section of the country from the Mississippi Valley to the Pacific Ocean; likewise a preliminary report upon the route followed by Capt. John Pope further south in Texas, made up from the notes and specimens collected by the latter. His claims as a geological discoverer rest upon the recognition of Carboniferous in Arkansas, the Permian and Carboniferous in New Mexico and Arizona, the Trias in Indian Territory, northern Texas and New Mexico. He thought also to have found the Jurassic, Neocomian and Chalk at different localities from New Mexico eastward. The geologists who have examined this field in later years and in greater detail have, in the light of all the geological knowledge that has accumulated since, assigned somewhat different ages to the beds described under the latter heads. This does not, however, detract from the value of Marcou's contribution to American geology, when one takes into consideration the circumstances under which his work was done and the little that was known of the geology of the West at the time.

Marcou did not make the official report upon his geological studies. When he was upon the point of embarking for Europe with his notes and collections, in order that, in working them up, he might be able to make comparisons with material in the museums abroad, they were seized by order of Jefferson Davis, then Secretary of War, and he was obliged to embark without them. His material was later worked up and the final report on the 35th parallel made by W. P. Blake, as official geologist of the expedition.

Blake's own observations were made as geologist in the expedition, under Lieutenants R. S. Williamson and J. G. Parke, in the summer of 1853, to determine the practicability of various routes from San Francisco through southern California to the mouth of the Gila River. The region is not one from which definite geological data could be obtained, the rocks, with the exception of recent and Tertiary formations, being barren of fossils and classed as metamorphic and eruptive. Eocene strata were recognized near San Diego, and Blake made interesting observations on desert phenomena, such as sand-polishing, prevailing west winds, etc. In economic geology he described the auriferous gravels and hydraulic washings, and concluded that the age of the formation of gold was contem-

poraneous with the uplift of the Coast Ranges and with the diorite or greenstone intrusions. His report was submitted in 1857.

1854–5. Dr. Thomas Antisell was geologist to Lieutenant Parke's expedition from San Francisco to Los Angeles through the Coast Ranges in 1854, and from the Pimas villages in Arizona, along the 32d parallel to the Organ Mountains, in New Mexico, in 1855. He considers the age of the Coast Ranges as post-Miocene, and notes the occurrence of bituminous deposits in southern California. He was influenced in his views on mountain ranges by Elie de Beaumont's theory of mountain uplift along the great circles, and endeavored to trace his systems in the West. He thus drew attention to the parallelism of the ridges in the great mountain ranges; the northwest trend in the Coast Ranges, the Sierra Nevada and the Arizona ranges, and the north and south trends in eastern New Mexico. He published colored sketch maps of sections of country passed through and indicated Carboniferous, Devonian and later rocks, but it appears that the only fossils he brought in were of Tertiary forms, and that his opinions as to age were based on the statements of other geologists and on lithological correspondence, and can be considered only as more or less well founded surmises.

1855. Dr. Newberry, as geologist of Williamson and Abbott's expedition from San Francisco to the Columbia River in the summer of 1855, noted the occurrence of Carboniferous and Cretaceous rocks in northern California, as evidenced by fossils collected by Dr. Trask, and that the Oregon coals of Coos Bay, Bellingham Bay and Vancouver Bay, probably of Tertiary (Miocene) age, rest on Cretaceous rocks, thus resembling the coals of the upper Missouri. He noted the existence of ancient glaciers at various points along the mountains, but gave no hints of active ones. He regarded the Sierras as of earlier upheaval than the Coast Ranges.

The contributions to the geology of the West in the period from 1855 to the Civil War had best be noted, not in strict chronological order, but geographically, taking first the southern region, next the interior, and finally the geology of the Great Plains.

1855–6. On the expedition to fix the boundary between Mexico and the United States under the treaty of 1854, which was conducted by Maj. W. H. Emory, Dr. C. C. Parry was geologist and botanist, and Arthur Schott, assistant geological observer.

In Maj. Emory's quarto report, first volume, are geological sketches of the country by Parry and Schott, with description of fossils by Hall and Conrad, and a general discussion of the geology of the region by James Hall. The report also contains a colored geological map of the Mississippi Valley and country to the west, which is the earliest colored geological map of the country west of the Mississippi published by the government.

The fossils described are mostly Tertiary and Cretaceous, and come in great measure from Texas. Upper Carboniferous limestones were identified at various points, and the presence of Silurian is suggested by Hall from a single fossil whose locality is not given. Hall discusses Marcou's section in northern Texas and New Mexico, and comes to the conclusion that the existence of any Mesozoic rocks in this region below the No. 1 Cretaceous, as determined by himself and Meek and Hayden, is not confirmed. The geological map prepared by him and Lesley is mainly interesting now as representing the blanks in the then geological knowledge of the interior of the Rocky Mountains. On the Great Plains his No. 1 Cretaceous included all that is now known as Trias, Jurassic and Lower Cretaceous, and was succeeded to the north by Upper

Cretaceous and Tertiary. Along a great part of the front of the Rocky Mountains and around the Black Hills was a strip of Upper Carboniferous and Upper Silurian separating the Cretaceous from the metamorphic nucleus. Likewise, along the face of several New Mexican ranges, in spots around Salt Lake and in the neighborhood of San Francisco Mountain, the Upper Carboniferous was represented. With this exception all the Western mountain region was indicated as metamorphic or unknown, as far as the Pacific Ocean, except for large areas of igneous and Quarternary in northern California and Oregon.

1857. To the expedition of Lieutenant J. C. Ives, sent out in the autumn of 1857 to explore the Colorado River from its mouth up to the head of navigation, Dr. J. S. Newberry was attached as geologist. A quarto report of this expedition was published by the government in 1861.

In this report Dr. Newberry summarizes the work that had been previously done in California, and makes the uplift of the Coast Ranges post-Miocene and probably later than the Sierra Nevada. His observations on the region of the Canyon of the Colorado are those of a trained geologist, and show a grasp of the broad conditions of structure of the Rocky Mountains much in advance of any previous observers. His published section of the rocks of the Grand Canyon, though not based in every instance upon direct lithological evidence, has not been essentially modified or improved by later observers up to the time of Walcott's investiation under the present Survey. The Algonkian formations between the Silurian and Archean do not occur in the region examined by him.

His general views on the structure of the mountains are seen in the following quotation (Ives Report, p. 47) :

"This much we can fairly infer from the observations already made on the geological structure of the far West, namely, that the outlines of the western part of the North American continent were approximately marked out from the earliest Paleozic times; not simply by areas of shallower water in an almost boundless ocean, but by groups of islands and broad continental surfaces of of dry land."

This remark was in opposition to the then generally received theory that the area of the Rocky and California mountains was till the Tertiary period occupied by an open sea.

1859. As geologist of the Macomb exploring expedition to the junction of the Grand and Green Rivers, Dr. Newberry collected much additional data on the geology of the plateau country. His report on the geology of the country, accompanied by a beautifully shaded topographical map made by Baron F. W. von Eggloffstein, was delayed by the confusion attending the Civil War, and was not published until 1876. It contains the following important additions to the geological knowledge of the region:

First, the determination of the Triassic age of the red sandstone by plant remains found at the copper mines of Abiquiu, New Mexico (Marcou's determination had been based on lithological evidence alone); second, the tracing of Upper and Middle Cretaceous formations along the south flanks of the San Juan into the upper Colorado Basin, and making a section of 6,000 feet of rocks from the Carboniferous to Cretaceous, inclusive; third, the finding of Saurian remains in the Canyon Pintado in the beds below the No. 1 Cretaceous, which, doubtless, represent the Atlantosaurus beds, since made famous by Marsh. Finally, although he only skirted around the isolated laccolitic mountains of that region, he shows a remarkable prescience in his remark upon the Sierra Abajo, that it has the appearance of a trachytic core pushed up through and uplifting Cretaceous strata.

In 1859 Capt. J. H. Simpson, of the Topographical Engineers, was commissioned by Gen. Albert Sydney Johnson, then stationed at Camp Floyd, Utah, to explore a new wagon road from Salt Lake Valley to the base of the Sierra Nevada, near Carson, and also eastward as far as Fort Bridger, in Wyoming. Henry Engelmann, of St. Louis, was appointed geologist of this expedition.

He showed unusual industry in collecting fossils and minerals, but his observations are those of a mineralogist rather than those of a stratigraphic geologist. From the determination of his fossils by Meek, it appears that he obtained Devonian forms in central Nevada, and lower Carboniferous in the Oquirrh Mountains of Utah, near Camp Floyd, thus determining lower horizons than had hitherto been known to exist west of the Missouri River.

Fossil-bearing Jurassic limestones were observed on the La Bonté Creek, near Fort Laramie, and on the western slope of the Wasatch, and a collection of fresh water fossils was made at the locality on Bear river, which for so many years puzzled paleontologists and geologists.

The probable Cretaceous age of the coal beds of the Weber Valley, and the San-Pete fields to the south was determined. He notes the widespread occurrence of eruptive rocks, especially through Nevada, but his lithological determinations, such for instance as that of phonolite, have to be accepted with some reservation, though they show more careful and intelligent study of their mineralogical composition than have been given by earlier geologists.

As his report was not published until 1875 (16 years after the observations were made), the facts determined were not available for the guidance of later explorers in in that region.

1853–6. The geology of the Great Plains is inseparably connected with the names of Meek and Hayden. They were first sent to the Bad Lands of Missouri by Prof. James Hall, in 1853. Hayden spent the summers of the two following years traveling with parties of the American Fur Trading Company, thus exploring geologically the Missouri Basin. He wrote a brief sketch on the geology of this region for Lieutenant Warren's 'Report on Explorations in the Dacota Country.' In this he mentions the Tertiary basin of White River, in which the great discoveries of vertebrate remains were then being made, the Bad Lands of the Judith River, and the great lignite basin extending from the mouth of the Cannon Ball River to that of the Muscleshell River.

1857. In 1857 he accompanied Lieutenant Warren to the Black Hills of Dakota, and submitted a report in November, 1858. (Reprinted in 1875, in Lieutenant Warren's 'Preliminary report on explorations in Nebraska and Dakota.') In this he gives a complete column of geological formations, as known in Kansas and Nebraska Territories, from the Potsdam upwards. The Potsdam had been detected by lower Silurian forms in the Black Hills. This and the discovery of the marine Jura, well represented by fossil forms, with fresh water beds just above them, which he was doubtful whether to place with the Jura or Cretaceous, and the discovery of vertebrates near the mouth of Judith River, which Dr. Leidy thought might be Wealden, constitute the important discoveries outlined in this report. The assumed existence of Devonian beds is evidently based on a mere conjecture which has not been substantiated.

1858. The summer of 1858 was spent by Meek and Hayden in making collections of fossils in Kansas Territory, and in 1859–60 Dr. Hayden served as geologist to the expedition of Captain W. F. Raynolds to the headwaters of the Missouri and Yellowstone Rivers. His geological work was in-

terrupted by the war, in which he served as surgeon in the army, and his report was submitted in 1867, but not printed until 1869. With this was a geological coloring of Raynold's topographical map, which gives in a very generalized form the current ideas with regard to the geology of the country east of the mountains. It shows the anticlinal structure observed in the Black Hills extended to all the ranges facing the plains. In the interior, granites, igneous and metamorphic rocks are all grouped under one color, and no formation between Carboniferous and Potsdam is recognized. The age of the coal-bearing beds is given as Tertiary.

1867. I will mention here the contributions of John LeConte in 1867, though not strictly in chronological order, nor under government auspices, yet they were part of the general scheme of exploration of the country for the projected Pacific railroad. He was attached to the party of Gen. W. W. Wright, of the eastern division of the Union Pacific Railroad, which was exploring various routes from Fort Lyon, Kansas, to Fort Craig, New Mexico. He made a more careful study of the coal-bearing rocks than had yet been made, and maintained his belief in spite of the evidence of fossil plants as interpreted by Lesquereux, that they were Cretaceous rather than Tertiary, a belief founded mainly on Molluscan fossils of Cretaceous age found by him in association with the coal beds, but in part also on a reasoning that the development of plant life in this country had not been strictly contemporaneous with that of Europe. On this point he says: "The difference between the plants of our early Cretaceous and those of the Middle Tertiary could be ascertained only by the aid of the stratigraphy of the region, and we have no right from a few resemblances in vegetables to infer the synchronism either of the Western lignite beds with each other, or any of them with the European Eocene and Miocene, except when supported by lithological evidence from animal remains.

"It would therefore appear plausible, in the absence of more direct evidence, to believe that since the introduction of dicotyledons in large numbers in our early Cretaceous there has not been any great change in the types of structure; and that such changes, while following in general plan those introduced on the eastern continent during this period, have not been synchronous with them."

He noted several unconformities in the beds, and presented a history of the orographic growth of the Great Plains in Mesozoic time, which shows a remarkably philosophical interpretation of the facts then known. His idea was that the region grew, by a series of gradual elevations connecting Paleozoic islands, into one landmass; that a great peninsula was developed running eastward from the Rocky Mountains and contracting the intercontinental Cretaceous ocean. Thus by the end of the Middle Cretaceous this ocean was divided into two gulfs, a northern and a southern, in which toward the end of that period the faunas became quite different. Finally, independent shallow basins were formed in which conditions for coal accumulation prevailed.

S. F. EMMONS.
U. S. GEOLOGICAL SURVEY.

(To be concluded.)

PHASES IN JAMAICAN NATURAL HISTORY.

PROF. J. E. DUERDEN,* Curator of the Museum of the Institute of Jamaica, has recently published an article which gives new and interesting data concerning the results of the introduction of the Mongoose to the Island.

* Contributions to the Natural History of Jamaica. By J. E. Duerden, Curator of the Museum of the Institute of Jamaica. Kingston, November, 1896.

The story of how the Mongoose was brought into Jamaica from India in 1872 for the purpose of destroying the imported European black and brown rats which were devouring the crops of the sugar-cane and other vegetal products, and how it increased until it became a veritable pest, is well known to history. The Mongoose thrived and exterminated the rats, and having enjoyed this diet, he began a series of food experiments upon all small domestic animals, especially poultry. In some instances, he even killed small pigs, kids, lambs, newly dropped calves, puppies, kittens. All kinds of game, such as partridges, quail, guinea-fowl, snipe, lapwing, ground doves, young buzzards, and all birds which nest on or near the ground, and their eggs were much to his taste, and he has been known to catch fish. He likewise, developed a special fondness for snakes, ground lizards, frogs, turtle and turtle's eggs, land crabs and other of the more humble creatures. Not only did his appetite crave the above animal diet, but it was rapacious in its assaults upon ripe bananas, pineapples, young corn, avocado pears, sweet potatoes, cocoas, yams, peas, and certain fruits. He even competed with his former enemy, the rat, in eating the sugar-cane, and did not hesitate in attacking salt meat.

As a consequence of the fecundity and omnivorous appetite of the Mongoose, Jamaica was soon rid not only of its rats, but of all the game and birds, except such, like the ground dove, as had the discretion to transfer their breeding places upon his advent, from the ground to the tops of the high prickly cacti. As a result of the Mongoose's tastes for reptiles, the twenty-two species of lizards and five species of harmless snakes, which had hitherto proved an inestimable blessing to the island in keeping down small insect pests such as the tick, fell victims to its depredations. Notwithstanding the humble sphere which the tick and chigor occupy in the scale of life, they were not so stupid as to fail to take advantage of this destruction of their hereditary enemies, and proceeded to thrive as they had never thriven before. These minute forms of life, which had previously confined their attention to cattle, increased so rapidly that they became a pest to mankind. One could not brush against the bushes or put his foot down in the grass without being covered by the small 'seed-ticks,' as the young are called.

As a final result of this series of wars between the various kinds of lower animals, the tick and Mongoose remained as the victorious survivors. So different were their spheres in life that it was generally concluded that their rule would continue undisputed for years.

Within the past few years, according to Prof. Duerden, another phase of the question appears to have been entered upon. He says: "It is reported from practically all parts of the island that the Mongoose is not nearly so plentiful as formerly. Some of those caught are found to be suffering from the attacks of ticks. The results of the diminution are shown in the appearance and marked increase of certain species of reptiles and birds; some already alluded to as supposed to have been exterminated. Amongst the snakes there is a very noticeable increase. During the past year several examples of the yellow snake have been received at the Museum, as well as notices of others. Specimens of the spotted-chinned snake are obtained almost weekly, especially from the vicinity of Kingston; and, occasionally, an example of the two-headed snake. During the last fifteen months, however, I have never heard of the occurrence in the island of an undoubted black snake nor of the pardaline snake. Perhaps the most obvious change, remarked by everyone, is the abundance of the ground

lizard, previously recorded as extinct. Hundreds are now to be met with on the outskirts of Kingston, where only a few years ago not one was to be seen. The woodslave is not rarely seen. Crocodiles are certainly more in evidence, especially on the south side; numerous eggs, young and adult forms being now brought to the Museum. There is not nearly the same outcry against the loss of poultry and domestic animals, particularly around the towns. Correspondents from the country state that bevies of quail are to be occasionally seen, and that the various pigeons and blackbirds are more numerous.

The attorney in charge of the largest sugar estate in the island gives information that lately more of his canes are being destroyed, due to an increase in the number of rats, and that ticks are not nearly so prevalent. There seems not the slightest doubt therefore but that the maximum influence, both for good and for evil, of the Mongoose, is passing away in Jamaica; first from the vicinity of towns, but not less surely from the country districts. Of the cause we can do little more than speculate at present.

The animals now returning in greater abundance were evidently never exterminated, but only extremely rare; so that, as their destroyer in the past is becoming less important, they are increasing towards their original proportions. New balances of life are being struck in the island, and further developments will be watched with interest."

ROBT. T. HILL.
U. S. GEOLOGICAL SURVEY.

THE INTERNATIONAL METEOROLOGICAL AND HYDROLOGICAL MEETINGS.

THESE were held last autumn in France, the first and more important being the International Meteorological Conference, which met at Paris, in the Hotel de la Societé d'Encouragement, September 17th to 23d, inclusive. It had the same official character as the similar conference at Munich in 1891, to which representatives of the principal meteorological services and observatories of the world were invited. There were at Paris about forty such representatives, besides several specialists who were invited to participate in the discussions. At Munich the United States Weather Bureau had two representatives, but at Paris, unfortunately, there was not one. Mr. J. Page represented unofficially the United States Hydrographic Office, and the writer represented the Harvard College and Blue Hill Observatories. No one came from either Spain or Brazil, as was the case at Munich, but Belgium, Canada and Mexico each sent a delegate to Paris, the two latter countries participating for the first time in an international meeting.

The meeting was called to order by Mr. R. H. Scott, secretary of the Permanent International Committee, and M. Mascart, director of the French Meteorological Office, was chosen president of the meeting. The programme of questions proposed for discussion was shortened by excluding questions which had been considered at previous Congresses or which were beyond the scope of this Conference. Action on some propositions was deferred and there was an unwillingness to aid anyone to influence his government. The postponed proposition for double thermometric stations was decided by recommending that a standard thermometer shelter be adopted in each country and that comparisons be instituted between it and other shelters, and especially the Assmann aspiration thermometer. Most of the questions were considered by sub-committees on meteorological telegraphy, instruments and methods of observations, cloud observations, terrestrial magnetism and atmospheric electricity, whose reports were substantially adopted by the Conference. Among the most important opinions expressed was a general recommendation by the first-named com-

mittee that the daily international dispatches to Paris be accelerated, so that they should be more useful in forecasting, pending the possible adoption of the American 'circuit system' in the European countries; the second committee refused to adopt either a standard anemometer or a uniform exposure for anemometers; and the third committee, after considering the delays which had occurred in commencing the international system of cloud observations in some countries, requested, when possible, that both nephoscope observations and theodolite measurements of clouds be continued throughout the year 1897, in order to obtain one whole year of observations for synoptic comparison. Probably the most noteworthy feature of the Conference was the attempt of the last named of the sub-committees to secure uniformity in magnetic surveys, and as regards instruments and methods of reduction both in the field and at the permanent stations. Resolutions were adopted favoring the use of captive balloons, free balloons, and unmanned, or pilot balloons for obtaining meteorological data in the upper air. Simultaneous ascents in the different countries and the prompt publication of the original observations were recommended. The success of kites at Blue Hill Observatory for elevating self-recording meteorological instruments led to the expressed desire that similar experiments should be made elsewhere.

The Conference reappointed the International Meteorological Committee, which was elected at Munich, except that three vacancies caused by resignations were filled. This committee of 17 is thus constituted: von Bezold, of Prussia; Billwiller, of Switzerland; de Brito-Capello, of Portugal; Davis, of Argentine Republic; Eliot, of India; Hann, of Austria; Hepites, of Roumania; Hildebrandsson, of Sweden; Mascart, of France; Mohn, of Norway; Moore, of the United States; Paulsen, of Denmark; Russell, of New South Wales; Rykatcheff, of Russia; Scott, of Great Britain; Snellen, of the Netherlands; Tacchini, of Italy. M. Mascart is the President, and Mr. Scott retains the position of Secretary to the Committee, which he has held for many years. The Committee appointed commissions to deal with problems relating to solar radiation, terrestrial magnetism and atmospheric electricity, cloud observations and meteorological aëronautics. The United States is represented in the two last-named commissions by the writer. French, English and German reports of the Conference will be published, respectively, by Messrs. Mascart, Scott and von Bezold. The date of the next conference was fixed five years hence, the place of meeting to be named by the International Committee.

During the Conference the meteorological institutions of Paris and its suburbs were visited. These included the Central Meteorological Office with its station on the Eiffel Tower and its meteorological and magnetical observatory at the Parc Saint Maur, the municipal observatories of the Tour Saint Jacques and Montsouris, and the new private observatory of M. Teisserenc de Bort at Trappes, which is devoted to dynamic meteorology and at present chiefly to the measurement of cloud heights by photography. The pleasantest feature of the Conference was the cordial relations which existed between all the members, and these were especially noticeable in the case of the French and Germans. At a breakfast given by M. Mascart on the Eiffel Tower, M. Rambaud, the Minister of Public Instruction, under whose patronage the Conference was placed, spoke of the international character of all science, but especially meteorology, since the air which we breathe belongs to no country and can be monopolized by no one.

The Fourth International Congress of Hydrology, Climatology and Geology,

which has been noticed already in SCIENCE, met at Clermont-Ferrand, in the Department of the Puy de Dôme, between September 28th and October 2d, inclusive. The first session was at Biarritz in 1886, but the geological section was added this year. The present Congress, open to anyone on payment of a fee, was attended by about two hundred persons, of whom more than half were French physicians, but its international title was sustained by the presence of official delegates and representatives of eleven other countries. The Congress was under the patronage of the Minister of the Interior who delegated Prof. Proust, general inspector of the Sanitary Services. Dr. de Ranse and Dr. Fredet, president and general secretary, respectively, of the Committee of Organization, retained these offices for the meeting. The foreign honorary president, chosen by acclamation, was Dr. Berthenson, of Russia, the foreign honorary vice-presidents being Prof. Ludwig, of Austria, Prof. Kuborn, of Belgium, and Mr. Rotch, of the United States.

The Congress met in three sections, but, as might be expected, the chief interest was in the hydrological section. The Committee of Organization had prepared printed reports upon questions pertaining to each section, which were read and discussed. The majority of the papers presented afterwards treated of the therapeutic properties of thermal and climatic stations, but there were three conferences on the history of hydrology, the geology and the climate of the region. The proceedings will be published under the direction of the Committee.

Outside the University, where the meetings were held, there was much to be seen, and in a volume specially prepared for the occasion the historical and physical features of the province of Auvergne were described. Unfortunately, the cold, rainy weather proved a drawback to sight-seeing. The climatological conference was given on the Puy de Dôme, at the observatory, which, built twenty years ago, was the first well-equipped mountain meteorological station in Europe. During the Congress, an exhibition of objects illustrating the neighboring thermal stations was open at Clermont. Entertainments were given by this municipality, and at a banquet offered by the management of the Thermal Establishment at Royat some international courtesies were exchanged. After the close of the Congress the more distant thermal stations were visited. The next session is intended to take place at Brussels in 1898.

A. LAWRENCE ROTCH.

A PROPOSED BUREAU OF PLANT REGISTRATION.

THE question of establishing a bureau for the registration of plants, in connection with the present Division of Pomology, was brought before the Section of Botany and Horticulture at the recent meeting of the Association of American Agricultural Colleges and Experiment Stations, by Prof. L. C. Corbett, of the West Virginia University. After a careful consideration of the matter, the Section appointed a committee to report upon the feasibility of the scheme, and to suggest the outline of a plan to be presented to Congress at an early date. The committee consisted of L. C. Corbett, Morgantown, W. Va., Chairman; W. A. Taylor, United States Department of Agriculture, Washington, D. C.; Prof L. H. Bailey, Ithaca, N. Y.; F. S. Earle, Auburn, Ala., and C. H. Shinn, Berkeley, Cal.

The idea is to have some one place in the United States where all plants placed upon the market can be officially registered, numbered, and a description, together with specimens of the bloom, seed, foliage and fruit, placed on record. When it is not practicable to preserve the original, colored casts are to be prepared, as in the case of

citrons, drupaceous and pomaceous fruit, as well as vegetables.

In all cases where plants are sent for registration, specimens of flowers, foliage, fruit, root, tuber or seed must accompany the application. All vegetables must be accompanied by a given amount of seed (to be determined) to be preserved for purposes of noting the duration of cultural varieties, the influence of climate during any series of years or in any locality. A further purpose of the seed shall be to grow plants for purposes of identifying the sort.

ENDS SOUGHT.

1. To discourage the duplication of names, and the re-naming of old sorts for commercial purposes.

2. To form a National herbarium of economic plants, which shall be made up largely of type specimens.

3. To simplify the matter of nomenclature.

4. To aid the student of varieties as well as of variation of plants under culture.

5. To secure the originator of a truly valuable variety some reward for his labor, the same as is now accorded the inventor.

The incorporation of such a clause (No. 5) will undoubtedly secure the hearty cooperation of all plant breeders, nurserymen and seedsmen, and this coöperation we must have in order to advance the scientific ends sought.

It is further proposed that this central bureau be made a part and parcel of the present Division of Pomology of the United States Department of Agriculture. A very valuable nucleus for the beginning of such work is had in the fruit models now in the museum of that department.

Each person interested in this matter will kindly formulate his ideas on the subject and send to some member of the committee who will put them in such form that a bill may be drafted at an early date and presented before Congress. The idea in having the members of the committee so scattered is to get the needs of the several sections of the United States as well represented as practicable. It is hoped that each one interested will lend hearty coöperation in the matter.

CURRENT NOTES ON PHYSIOGRAPHY.

PHYSICAL FEATURES OF MISSOURI.

THE current annual volume of the report of the Missouri Geological Survey contains an essay on the physical features of that State by C. F. Marbut(Vol. X. 1896, 14–109). The general upland of the State, bevelled obliquely across the nearly horizontal strata, is explained as a peneplain produced by subaerial erosion that continued into Tertiary time; the peneplain now being dissected in consequence of a warping uplift of middle or late Tertiary date. Apart from the narrow valleys by which much of the upland is dissected, the most notable features of the State are the escarpments that are formed on the retreating edges of the harder strata. A number of these are described, mapped and figured. The most important are the Bethany escarpment, formed on the resistant members of the upper coal measures in the northwest corner of the State; the Burlington escarpment, on the Burlington limestone in the southwest; and the Avon, Crystal and Burlington escarpments on a series of hard strata near the confluence of the Missouri and the Mississippi, below St. Louis. The lower ground that spreads out in front of an escarpment is called a platform; the upland, to which the escarpment rises, descends again in a back-slope or structural plain. The relief form included by the back-slope and the escarpment is called a ridge; the special term, *cuesta*, might be introduced to advantage. The drainage system of the State is discussed at some length, with special reference to the origin of incised

meanders. A brief and elementary presentation of the problems here discussed elaborately would be very serviceable to the schools of Missouri.

THE GLACIERS OF NORWAY.

Two previous notes on Norwegian essays by Richter, of Graz, have been given in these columns. His latest article concerns the Norwegian glaciers (Hettner's Geogr. Zeitschr. II., 1896, 305–319), a subject on which he is particularly well qualified to write after his minute studies of the glaciers of the eastern Alps. The Folgefond highlands have about a sixth of their area ice-covered; this part being comparatively smooth, while the rest is much more dissected. Hence it is argued that the inactive ice sheet has been protective of the highland surface. Richter places the snow line here at 1,450 met., dissenting from the estimate of 1,025 by Sexe. The descending glacial branches from the highland ice sheet vary in shape according as they form broad ice paws in the high-level, shallow, upland valleys, or long, steep, slender ice tongues in the deep fiord valleys. The Folgefond has only two or three glaciers of the second class, and twenty or thirty of the first. These two classes should not be paralleled with glaciers of the first and second order in the Alps. The highland from which the Jostedals glacier descends, for which Richter suggests the name Jostefjeld, possesses a number of round and peaked summits (1,900 met.) that rise above its general level (1,600). While the latter is ice-covered, the former are bare; and this difference is ascribed to wind action. The snow line here stands at 1,600–1,650 met. Langefjeld and Jotunfjeld are also described.

LANDSLIPS IN SWITZERLAND.

ONE of the frequent landslips and torrent washes of the Alps occurred last May on the south slope of the Rothorn ridge, near the east end of Lake Brienz. It is described by H. V. Steiger (Mitth. Naturf. Gesellsch., Bern, 1896, with illustrations). The Lammbach has here built a large alluvial fan between the villages of Kienholz and Hofstetten, on which it from time to time spreads floods of stone and gravel, fed by landslips in its headwater ravines, where rifts in the upper ground show that a repetition of such disasters may be expected for years to come. The length of the recent stony torrent from its source to the lake is 3½ k.; its breadth where widest near the lake, 120 m.; its thickness at the same place, 2½–3 m., increasing up stream to 4 m. The advance of the wash was at a variable rate, sometimes so slow that the grass in front of it was saved by mowing. On escaping from the incised upper valley, the torrent turned sharply to the right on the lateral slope of the fan. Its spreading lower course is well shown in a large photo-print. Although even these small slips are of economic importance in a closely occupied country like Switzerland, they are insignificant compared to the colossal Topinish and Simcoe landslides in Washington, described by Russell (Bull. 108. U. S. G. S.).

HEILPRIN'S EARTH AND ITS STORY.

'THE Earth and its Story,' by Prof. Heilprin, of the Academy of Natural Sciences of Philadelphia, is a 'first book of geology' (Silver, Burdett and Co., Boston, 1896, 266 pp.), in which there is a decided physiographic flavor, thus giving much support to the contention of the report of the 'Committee of Ten' that geology proper– the study of the Earth in relation to time—may be well left over to collegiate years, while physiography supplies the natural preliminary training in the high school. The book is simply written, and its chapters follow a well-chosen order. The illustrations are as a rule good, but in some cases there is here, as in many recent books, an example of the too great confidence in 'process' reproduc-

tion of photographs. The upper half of Plate 20 reduces Holmes' drawing of the shore lines of Lake Bonneville, from Gilbert's monograph; the lower half represents the floor of an extinct lake in the Swiss valley of Engelberg, from a photograph; and the first is distinctly more educative than the second. The Delaware and Grand Rivers, Plate 16, are not successful reproductions; good drawings would be more instructive, even if less accurate than the original photograph; but good drawings cost too much nowadays. Brevity of treatment in a number of passages calls for the aid of a good teacher before the student will understand the problems discussed.

W. M. Davis.

Harvard University

CURRENT NOTES ON ANTHROPOLOGY.

AMERICAN GAMES AS EVIDENCE OF ASIATIC INTERCOURSE.

In the Internationales Archiv für Ethnographie (Bd. IX., Supp.), Dr. E. B. Tylor returns with fresh zeal to his ancient contention that the presence of two games so much alike as *parcheesi* in India and *patolli* in Mexico shows intercourse between the continents before the time of Columbus.

This betrays a regretable misconception of the principles of ethnology as now adopted by its foremost students. Games are alike because men are alike the world over. The same similarity extends to myths, social constructions, laws and arts. That Lewis F. Morgan, forty years ago, should insist that the Iroquois of New York learned their totemic system from East Indians was pardonable in that day. Now it scarcely would be.

Dr Tylor should also study his ethnography closer. The Tarahumaras are not 'a distant people of an alien language' to the Aztecs, but closely related and speaking a tongue of the same Uto-Aztecan stock. That is why they call the game *patole*.

RACIAL STUDIES IN SWITZERLAND.

In the first number of the new Swiss 'Archiv für Volkskunde,' Dr. Rudolph Martin, of Zurich, urges a complete and careful study of the living adult population of Switzerland, "in order to determine what types represent pure varieties, and what others indicate hybrid forms."

He proposes that the observer should use only a few simple implements, an anthropometer and a calliper, costing together about 85 francs. These, he suggests, could be provided by a society and loaned to observers who would find it inconvenient to purchase them.

His paper is supplemented with blank forms, showing what observations are desirable. These give the individual's name, age, birthplace, etc.; then his measurements, 28 in all; and his descriptive criteria, color of hair, eyes and complexion, shape of head, face, nose, etc. These items he believes would be ample for the purpose.

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

Dr. Emil Heinr. DuBois-Reymond, professor of physiology in the University of Berlin, died on December 26th, at the age of seventy-eight years.

The Emperor of Germany has conferred upon Dr. Roux the Royal Order of the Prussian Crown of the second class, which is said to be the highest decoration in his gift. It will be remembered that this order was conferred upon Pasteur some two years ago and declined by him. The German Emperor has in this case shown tact in conferring the order on one who in many ways is Pasteur's successor, and who it is understood will accept it. Dr. Behring, the discoverer, with Dr. Roux, of the antidiphtheretic serum, has had the Grand Order of the Crown of Italy conferred on him.

The Czar of Russia has conferred on M. Gérard, director of the Municipal Laboratory,

Paris, the Cross of the Commander of the Order of St. Anne; the Cross of St. Stanislas on Dr. Bordas, sub-director of the laboratory, and on Dr. Bertillon, director of the anthropometric service.

PROF. E. ABBE, of Jena; Prof. R. Fittig, of Strasburg, and Prof. J. Wislicenus, of Leipzig, have been elected corresponding members of the Berlin Academy of Sciences.

MR. RICHARD RATHBUN has been appointed assistant in charge of the Smithsonian Institution to succeed the late Mr. W. C. Winlock.

M. PERROTIN has resigned from the directorship of the Observatory in Nice to accept a position in the Astro-physical Observatory at Meuden.

NINE works are placed in competition for the Lobachévski Prize at Kazan, Russia, of which three are from America. It is probable that the prize will be awarded to the Third Volume of the 'Theorie der Transformationsgruppen,' by Sophus Lie.

IT is stated in *Natural Science* that the Geological Society of Stockholm has completed twenty-five years of active life, and the fact is commemorated in a special number of its Förhandlingar.

MR. F. W. STOKES, an artist who accompanied the Peary expedition of 1892 and the North Greenland expedition of 1893-4, is now exhibiting at the Fifth Avenue Art Galleries, New York, paintings of Arctic scenery.

LADY PRESTWICH has given to the British Museum the collection of fossils of the late Sir Joseph Prestwich.

THE Arctic Club held its annual dinner in New York on December 26th, Prof. W. H. Brewer presiding. Dr. Frederick A. Cook stated that he was beginning the work of organizing an expedition to the Antarctic regions.

WE are asked to state that the time for the sending in of essays for the Welby prize is extended to January, 1898. Prof. Émil Boviac has been added to the committee of award.

THE Biological Society of Washington has elected officers for the ensuing year as follows: President, L. O. Howard; Vice-Presidents, Richard Rathbun, C. D. Walcott, B. E. Fernow, F. V. Coville; Recording Secretary, Charles L. Pollard; Corresponding Secretary, F. A. Lucas; Treasurer F. H. Knowlton.

PROF. CHARLES R. CROSS, of the Massachusetts' Institute of Technology, began on December 29th a course of eight lectures at the Lowell Institute, on the X-rays of Röntgen and related Phenomena of Electric Discharge.

THE Texas Academy of Sciences have sent out a preliminary program for the formal meeting in San Antonio on December 31st. Papers were promised by Mr. Thomas Fitz-Hugh, Dr. C. F. Francis and Mr. W. W. Norman, and addresses by Maj. C. E. Dutton and Dr. G. B. Halsted, the President of the Academy.

AN international exhibition for hygiene, alimentation and industrial art will be held at Lille during the months of March and April, 1897.

FOLLOWING the explosion of acetylene in M. Pictet's laboratory at Paris, another serious explosion has occurred in Berlin, kiling Mr. G. Isaac and three assistants, who were experimenting with acetylene.

THE anthropometric system for the identification of habitual criminals has been extended to Ireland, so that it is now in operation throughout the United Kingdom.

DR. S. C. CHANDLER states in the last number of the *Astronomical Journal* that, feeling the desirability of counsel and collaboration in the conduct of the *Journal*, he has invited Prof. Asaph Hall and Prof. Lewis Boss to share in its editorship, and they have accepted.

Harper's Magazine for January contains an illustrated series of articles on the progress of science during the century, by Dr. Henry Smith Williams.

WITH its issue of last week the New York *Medical Record* completed its fiftieth volume. Since its foundation it has been edited by Dr. George F. Schrady and published by William Wood & Co. The *Journal* has grown with the advance of medical science, to which it has in no small share itself contributed.

THE New York Board of Education has appointed 150 physicians to act as medical inspectors, one for each school district in the city.

This action will undoubtedly lead to a diminution of contagious diseases among children.

According to the *British Medical Journal* the Italian General Medical Council has presented a request to the government to the effect that all foreign doctors should be prohibited from practicing in Italy.

An exhibition will be held early next year at the Imperial Institute, London, illustrating progress in sea-fishing, yachting and life-saving appliances.

The Secretary of the Interior has recommended, through the Treasury Department, an increase in the salaries of the Commissioner of Education and of some other officers of the Bureau. The present Commissioner, Dr. W. T. Harris, to whom education and philosophy in America is so greatly indebted, receives an annual salary of $8,000 only, which is no more than that of some of the principals in the New York City public schools. There seems no reason why the Commissioner of Education should not receive as high a salary as the Commissioners of Indian Affairs or of Railroads, for as Mr. Francis, the Secretary of the Interior, writes: "The dignity of the Bureau of Education is certainly equal to that of other Bureaus of the Department, and the character of the work done therein is certainly of no less importance."

A case of alleged telegony was exhibited by Mr. Chalmers Mitchell at a recent meeting of the London Zoological Society. Sir Everett Millais, who has had much experience in the breeding of dogs, believed it to be a case of reversion, and so explained all cases of reputed telegony. Mr. Tegetmeier, who has also had much experience in breeding, concurred in this conclusion. At the same meeting Mr. Leonard Hill reported that he was unable to confirm Brown Séquard's results on the Inheritance of Aquired Characteristics following division of the cervical sympathetic nerve.

A recent issue of the Washington *Star* contains an account, by Mr. Frank G. Carpenter, of a trial of Prof. Langley's Aerodrome witnessed by him on November 28th, together with an interesting interview with Prof. Langley on his researches. On the day in question the aerodrome was launched from a boat in the Potomac River about 30 miles below Washington, and flew nearly a mile in 1¼ minutes, when it gently rested on the water. Its flight was only limited by the exhaustion of the water, less being used than the machine could carry. Prof. Langley is reported to have said: "I have proved both theoretically and practically that machines can be made which will travel through the air. The question of the development of the fact is one of the future. My motive and interest in the work up to this time have been purely scientific ones, but if I had the time and money to spend upon the construction of a large machine I believe I could make one on a scale such as would demonstrate to the world that a large passenger-carrying flying machine can be a commercial as well as a scientific success. There are many things yet to be learned concerning it, but I have no doubt that they will be discovered in the future. The moment that men see that such machines are not only practicable, but that they may be made commercially profitable, there will be a thousand inventors working upon the problem where there is now one. I believe, however, that the flying machine will first come into national use in the arts of war rather than those of peace. In an event of a great war by means of an aerial machine the armies of one nation will be able to know exactly what those of the enemy are doing, thus radically changing present military strategy and tactics, to say nothing of their power of dropping down bombs out of the sky. I believe, however, that such inventions will finally be of even greater advantage in the arts of peace. I have faith that the swiftest, and perhaps the most luxurious, if not the safest, traveling in the future may be through the air."

We recently noted the transfer of the publication of the *Botanical Gazette* to the University of Chicago, where it is printed in an enlarged form and with the highest degree of typographical excellence. In the current number of the *American Naturalist* Dr. Bessey gives some interesting details in regard to the evolution of the journal. It first appeared twenty-one years ago, in November, 1875, under the name of the *Botanical Bulletin*, edited by John M. Coulter, then professor of Natural

science in Hanover College, Ind. It consisted of four pages and the first volume contained only 52 pages of short and mostly local notes. The name of the journal was changed to the *Botanical Gazette* at the end of the second volume, and M. S. Coulter become one of the editors. In 1883 the editorship was undertaken by the present editors, John M. Coulter, Charles R. Barnes and J. C. Arthur, under whose control the journal has steadily improved up to the present time, when the name of G. F. Atkinson, V. M. Spalding, Roland Thaxter and William Trelease have been added as associate editors. As Dr. Bessey says, the *Gazette* "has thus been a growth, and it represents to-day much more than so many pages of printed matter. It has grown and developed as the science of botany has grown and developed in this country. When we look over the earlier volumes with surprise at the little notes which fill the pages we must not forget that American botany had not then generally risen above such contributions. It is true that we had a few masters in the science, with Dr. Gray still in his prime, but these masters wrote little for general reading, and their technically systematic contributions were mostly published in the proceedings of learned societies. The one thing which stands out to-day in sharp contrast with the botany of two decades ago is the very great increase in the number of masters in the science who are making liberal contributions from many different departments. The many-paged *Gazette* of to-day, with its rich variety of matter, differs no more from the four-page *Bulletin* of 1876 than does the botany of the two periods."

UNIVERSITY AND EDUCATIONAL NEWS.

IT is reported by cablegram that Alfred Nobel, the Swedish engineer and chemist, who died at San Remo, Italy, on December 9th, left a will bequeathing his entire fortune, amounting to about $10,000,000, to the Stockholm University.

THE will of the late Henry L. Pierce, distributes about three and a-quarter million dollars in public bequests, which include $50,000 to Harvard University and $50,000 to Massachusetts Institute of Technology.

DR. JOHN J. MCNULTY has been appointed professor of moral and intellectual philosophy in the College of the City of New York.

THE new catalogue of Harvard University shows a registration of 3,674 students, an increase of 74 over last year. There has been a slight decrease in the College, but a gain in the Lawrence Scientific School, in the Graduate School and in the Medical School. There has been an increase of 4 professors and 17 instructors.

AT Cambridge University the report of the General Board of Studies, recommending that steps be taken for the immediate appointment of a professor of mental philosophy and logic, was opposed upon financial grounds and because the establishment of the professorship was not urgent. The report was, however, adopted, by 120 votes to 70. The offer of Prof. Sidgwick to reduce his stipend as professor of moral philosophy from £700 to £500 per annum from the time of the appointment of the professor of mental philosophy and logic until midsummer, 1902, or until his chair be vacated, if that should occur before midsummer, 1902, was accepted.

DISCUSSION AND CORRESPONDENCE.

VAN BENEDEN AND THE ORIGIN OF THE CENTROSOME.—A CORRECTION.

I WISH to correct an error in my recent book on 'The Cell,' which misrepresents Van Beneden's early views regarding the origin of the centrosomes in the fertilized egg. At page 157 the view, or rather surmise, is attributed to him that, in the fertilization of *Ascaris*, one centrosome of the first cleavage-amphiaster is derived from the egg, the other from the spermatozoon. I am indebted to my friend, Prof. Conklin, for pointing out that through a misapprehension of Van Beneden's meaning I am in error on this point. Van Beneden did not, in fact, commit himself to any positive conclusion, but at page 272 of his paper of 1887 expressed the opinion that both attraction-spheres, and hence by implication both centrosomes, were derived from the egg, *i. e.*, from the second pseudo-karyokinetic (maturation) figure. Later researches, it is true, have almost conclusively shown that this opinion cannot be sustained;

but this does not lessen my regret at having unintentionally misrepresented the views of the distinguished leader of cell-research for whose splendid discoveries every investigator must feel such admiration.

EDMUND B. WILSON.

COLUMBIA UNIVERSITY,
NEW YORK, December 19, 1896.

THE VELOCITY OF A FLIGHT OF DUCKS OBTAINED BY TRIANGULATION.

MEASUREMENTS of the heights and the velocities of clouds are now being made at the Blue Hill Meteorological Observatory by Mr. Rotch as a part of an international scheme for such work. The measurements are made with specially constructed theodolites in which a large conical tube, with crossed wires at one end and an eye-piece at the other, replaces the ordinary telescope.

On the morning of December 8th, while Mr. S. P. Fergusson and I were engaged in measuring clouds, a flock of ducks passed across our base-line, which is 2590.3 metres (8496 feet) in length. We succeeded in getting one simultaneous set of measurements on the apex of the flock from which its height was calculated, and one or two independent subsequent observations, from which the velocity was calculated. The height was 958 feet above the lower station, which is situated in the valley of the Neponset river, above which the ducks were flying.

The velocity of flight calculated from this measurement of height, and from the angular velocity measured at one end of the base-line is 47.9 miles in an hour, and from the angular measurements made at the other end of the base-line is 47.7 miles an hour, making a mean of 47.8 miles. The wind was very light, having a velocity of only two miles an hour according to the automatic record made at Blue Hill Observatory, 615 feet above the valley station. The direction of the wind was from the north, and the ducks were flying from the northeast. These observations were not in our program, but they may prove of interest to ornithologists and students of aëronautics.

H. HELM CLAYTON.

BLUE HILL METEOROLOGICAL OBSERVATORY,
READVILLE, MASS., December 21, 1896.

A TEST ON DIVERSITY OF OPINION.

TO THE EDITOR OF SCIENCE: It is always interesting to test diversity of opinion, particularly on questions of exact reasoning. It is quite difficult to obtain a test which is at once significant and general. I should be very much indebted to those of your readers who would be willing to send me answers to the following request.

Here is a piece of reasoning which is certainly capable of arousing criticism:

Granted that A is B, to prove that B is A.

B (like everything else) is either A or not A.

If B is not A, then by our first premise, we have the syllogism:

A is B;
B is not A;
∴ A is not A; which is absurd.

Therefore, B is A.

Is this reasoning correct or is it not? If regarded as correct, my request is to have the reasons for its correctness given as explicitly as possible. If it is regarded as incorrect, I wish in the same way a very explicit statement of the nature of the error. Answers are requested from all who are interested in the matter. I am particularly desirous of receiving replies from those whose interest in thought is a philosophical one, as well as from those who are more specially devoted to scientific pursuits.

JOSEPH JASTROW.

UNIVERSITY OF WISCONSIN,
MADISON, WIS., December 5, 1896.

SCIENTIFIC LITERATURE.

A Geographical History of Mammals. R. LYDEKKER. Cambridge Geographical Series. Cambridge (England) University Press. 8° pp. 400, col. map and figures in text. September, 1896. For sale by The Macmillan Company, 66 Fifth Ave., New York City. Price, $2.60.

The subject of the geographic distribution of animals is not one to be mastered in a few weeks or months, and many are the pitfalls that lie in wait for the author who seeks to illumine its difficult problems. It is rare, indeed, that a writer in his first essay on this theme suddenly leaps to a position of authority, yet this is precisely what Mr. Lydekker has done. He has approached the subject from a new direction—

that of the extinct ancestors of existing faunas —and has brought together a multitude of significant facts which no one but a paleontologist could safely venture to attack. The result is a volume which, in spite of the imperfections and errors incident to so great an undertaking, will rank among the standard works on Geographic Distribution for many years to come.

The influence of man on the dispersion of animals is excellently told. Mr. Lydekker says: "Probably ever since man has existed in any numbers on the globe he has been exerting a more or less strongly-marked influence on the distribution of animals, either by destroying them or by conveying them to countries or districts which are not their natural home. By the involuntary aid of man the common rat and mouse, which belong to a genus unknown in the New World, have been conveyed to every country in the globe; while the rabbit has been carried to the antipodes, where it has flourished and increased in an unprecedented manner. Cattle and horses have been introduced into South America, Australia and other countries where they were naturally unknown, and by their rapid increase have shown that the absence of particular animals from particular districts is not necessarily due to their being unsuited to live there, but rather to the fact that they have been unable to find their way thither. The fallow-deer, again, has been imported from its Mediterranean home into England and other countries of northern Europe; while goats and pigs have been carried to a number of oceanic islands, where they have done irreparable harm in exterminating the native fauna and flora." Sheep also might have been mentioned among the potent destroyers of native floras. "In all these instances," Mr. Lydekker continues, "the fact of the introduction has always been more or less clearly known, and therefore no difficulty arises as to what are native and what are introduced forms. Very different, however, is the case with the Islands of the Malay Archipelago, where the natives, who have a wonderful facility for taming animals, have carried a species peculiar to one district or island to localites where it is quite unknown as a native; and in consequence of this transportation and acclimatisation it is probable that several mammals have been given a habitat to which they have not the most remote right. To the Malays is due the introduction of the small civet known as the rasse into Madagascar. Whether the dingo, or native dog of Australia, was introduced at an exceedingly remote era by the original colonizers of that island, or whether it is truly indigenous, is a question that will probably never be decisively answered. It is likewise quite impossible to say what part man may have played in the extermination of the large mammals that inhabited Europe about the close of the glacial period, but it seems quite probable that he may have had a considerable share in their destruction. Be this as it may, the domestication of certain mammals, has undoubtedly had the effect of destroying the wild race, as is remarkably exemplified by the two existing species of camel, of neither of which do we know the original habitat." (pp. 16-17.)

In treating of barriers to dispersion Mr. Lydekker revives the fallacy that "high mountain ranges form an effectual barrier to the migration of mammals," but he cites no examples. It is true that in many instances, as in the Himalaya, mammals inhabiting the lands on opposite sides of the mountains are widely different. But this is due to a radical difference in the climates or physical features of the countries themselves, and not to the presence of the intervening mountains. Does any one know of the existence of a mountain range in the whole world which is continuously high enough and long enough to keep mammals from crossing it or passing around it if the country on both sides is suitable to their needs? Mountains are barriers to distribution only so far as their own mass is concerned.

While expressing his general adherence to the view that after mechanical barriers, such as oceans, temperature is the chief factor in fixing the limits beyond which species and genera do not pass, he cites as exceptions the time-worn cases of the puma and tiger, using these names in the sense of species. He says: "There are several species, more especially among the carnivorous mammals, which seem quite independent of both station and temperature, the New World puma ranging from Patagonia to Canada, while the tiger inhabits alike the burning jun-

gles of India and Burma, and the Arctic tundras of Siberia." It may be poetic license, but hardly scientific truth, to speak of the tiger as an inhabitant of 'Arctic tundras.' And Mr. Lydekker must be aware that the northern tiger differs so markedly from the southern that it is regarded by some naturalists as a distinct species and has received a distinctive name. Our American puma also is a composite beast, differing widely in different parts of its range.

Other cases of the same sort that have been often cited are those of the wolf and ermine weasel. In discussing this subject five years ago I said: "With the possible exception of the gray wolf, not a single species of mammal ranges throughout the Sonoran and Boreal Zones, though a number are common to the Upper Sonoran and Lower Boreal (Canadian); and in the case of the wolf it is almost certain that comparison of specimens will show the animal of the southern United States and Mexico to be perfectly distinct from that of Arctic America. The ermine is another species of phenomenal though less extensive range, if it is really true that the weasel inhabiting the shores and islands of the Polar Sea is specifially identical with that found in the more elevated parts of the Southern States—an assumption I cannot for a moment entertain."*

Since this was written it has been found that the northern and southern wolves are very different, and that the weasels inhabiting North America from the Arctic barren grounds to Mexico belong to no less than five different species, each characteristic of a particular climatic belt!

That Mr. Lydekker is a 'lumper' of species is well known, and is exemplified by his statement that in North America we have only a single species of porcupine (*Erethizon*) and only one of little spotted skunk (*Spilogale*)! The way he unites European and American mammals has been pointed out in this JOURNAL in reviews of his earlier works.† In the present volume he maintains his reputation in this direction, stating or implying that Eurasian and American wolverines, martens, wolves, foxes, bears, lynxes, moose, reindeer and sheep are not specifically separable. With respect to the sheep he says: "The Kamschatkan wild sheep is so closely related to one race of the big-horn, or Rocky Mountain sheep that it is very questionable whether the two are really entitled to specific distinction." If Mr. Lydekker will take the trouble to glance at the skulls of these two animals, or even at the rather crude figures published by Guillemard in the Proceedings of the Zoological Society of London for 1885 (pp. 676–677), I do not think his faith in their distinctness will ever again be shaken.

Of the lesson to be learned from cases of discontinuous distribution, Mr. Lydekker states: "Examples of 'discontinuous distribution' among genera are of the very highest import to the science, since they clearly indicate that some of the lands lying between its present disconnected distributional areas must have formerly been the habitat of the genus, and thus enable important conclusions to be drawn as to the former land connections between such areas." But at the end of the book he implies his belief in the dual origin of both species and genera. He says: "The suggestion that *Equus* has thus been independently evolved in the two areas has been already mentioned, and this idea receives support from some very remarkable observations recently made on the invertebrates inhabiting certain European and North American caves * * * if animals which appear to belong to one and the same species can be proved to have had a dual origin in the one case, it can scarcely be considered impossible that similar instances may occur in the other. And if such dual origins exist among species, there is surely no reason why they should not occasionally occur in the case of genera. It would, therefore, seem by no means improbable that the species of the genus *Equus*, which inhabited the eastern and western halves of the northern hemisphere during the close of the Tertiary period, may have been evolved from the closely allied but separate ancestral equine stocks."

Respecting the geographic origin of types, the author holds the extreme view that "at least a very large proportion of the animals that have populated the globe in the later geological

*Proc. Biol. Soc. Washington, VII., 48, April, 1892.

†See SCIENCE, April 5, 1895, pp. 387–389; July 5, 1895, pp. 18–21.

epochs originated high up in the northern hemisphere, if not, indeed, in the neighborhood of the pole itself."

In some instances Mr. Lydekker calls particular attention to the widely different climatic conditions prevailing in Tertiary times from those of the same areas in our times, with consequent dissimilarities in past and present faunas; in other cases he assumes that the boundaries of existing faunas coincide essentially with those of the antecedent fossil faunas of the same area. Thus while explaining the great differences in the past and present life of the Arctic region on the ground of changes of climate, he would have us believe that the Sonoran region has maintained essentially its present boundaries since the days when it was inhabited by the remarkable extinct mammals known as Creodont Carnivora, Oreodont Ungulates, Protoceras, Camels, Titanotheriums, Coryphodons and others, all of which he regards as of Sonoran origin. While of much interest to know what types originated in this geographic area, does anyone imagine that its climate, when these extraordinary animals lived there, was the same as to-day?

But all this is preliminary. Coming to the real subject of the book Mr. Lydekker parcels off the globe into the following primary and secondary divisions:

I. Notogæic Realm.—1. Australian Region.
2. Polynesian Region.
3. Hawaiian Region.
4. Austro-Malayan Region.

II. Neogæic Realm.—Neotropical Region.

III. Arctogæic Realm.—1. Malagasy Region.
2. Ethiopian Region.
3. Oriental Region.
4. Holarctic Region.
5. Sonoran Region.

To discuss this scheme with the fullness its importance deserves would require far too much space for the limits of the present review. The primary regions, or 'realms,' may be passed without comment, inasmuch as few writers agree on their numbers or boundaries; and little will be said of the paleontological side of the book or of the facts of present distribution outside of the Americas.

Mr. Lydekker accords to South America the high distinction of primary rank, making it one of the three great 'realms' into which he divides the whole world. But he fails to see in its diversified faunas more than a single division of secondary rank—the 'Neotropical region'—whose boundaries he conceives to be coincident with those of the 'Neogæic realm;' and it is not until we come to divisions of the third rank, or 'sub-regions,' that he finds it necessary to take into account the widely different faunas that characterize the tropical forests, the grassy pampas and the lofty Andes. This seems scant justice, particularly by contrast with North America, where three full 'regions' are admitted. The number of Neotropical 'sub-regions' recognized is four, two of which—the Mexican and the Antillean—are northern outliers, leaving only two for the whole continent of South America. Of these, the first, or 'Brazilian subregion,' "is essentially an area of dense tropical forests, locally interspersed with open pastures or 'campos.' The second is the Chilian subregion, comprising Chili, Argentina proper, Uruguay, Patagonia and such portions of Peru and Bolivia as are not included in the preceding. It is chiefly an area of open plains and pampas, although including the high Andes."

If it could be assumed that Mr. Lydekker was unacquainted with the mammal faunas of South America, such a classification might be attributed to an imperfect knowledge of the facts, but his own enumeration of the characteristic genera and families of the different areas precludes this view and shows that the difficulty is mainly one of interpretation.

In speaking of the Mexican extension of the Tropical fauna, Mr. Lydekker makes the shocking statement: "Dr. Hart Merriam has proposed to unite Central America with the West Indies to form a separate zoological region—the Tropical—of equal rank with the Sonoran; but, however much may be urged in favor of this view, the multiplication of regions is much to be deprecated." It is hard to understand how any contortion of the imagination could give birth to such an overwhelming misconception. As a matter of fact, I simply remarked, after defining the Sonoran region, that the lowlands of Mexico, Central America and the West Indies belong to the American Tropical region—

without attempting any subdivision whatever—and using the term 'Tropical' in precisely the sense in which 'Neotropical' is commonly employed.

Another case of unintentional misrepresentation occurs on page 364 with reference to the peninsula of Lower California. At the end of a quotation from my Presidential Address on the Geographic Distribution of Life in North America he says: "The proposal to form a separate region for such an insignificant area as the southern extremity of California seems unnecessary, although its fauna may differ considerably from that of the typical Sonoran"—implying that I suggested its erection as a 'separate region,' whereas the rank I really gave it is the trivial one of a 'subdivision' of a 'zone.' I said: "The peninsula of Lower California is a subdivision of the arid Lower Sonoran Zone. Not a single genus of land mammal or bird is restricted to it and but two peculiar species of mammals have been described."*

In the same connection it might be mentioned that the only one of my papers on the life areas of North America quoted by Mr. Lydekker was published in the spring of 1892. Subsequent papers, containing certain modifications of the views expressed in 1892, together with much additional matter, are not referred to.

The part of the book which is probably of greatest importance is that which treats of the fossil vertebrates of South America. Mr. Lydekker has himself visited Argentina, and therefore should speak with authority. The paleontological discoveries of Ameghino in southern South America are of surpassing interest. Ameghino unearthed the fossil bones of a fauna which was not only previously unknown, but whose ancestry could not be clearly pointed to in any part of the world. The subsequent study of this fauna has developed some of the most interesting and far-reaching problems with which naturalists and geologists have had to grapple. These problems relate to the ancient land connections of South America and to the origin and lines of evolution of important groups of mammals and birds.

*Proc. Biol. Soc. Washington, VII., p. 29, April, 1892.

Our own distinguished paleontologist, Prof. W. B. Scott, in an address delivered a year ago before the Society of American Naturalists, stated that the earlier Miocene mammals of South America "are totally different from those of the northern land-masses, so much so that the correlation of horizons becomes a matter of extreme difficulty. The hoofed animals all belong to orders unknown in the north—*Toxodontia*, *Typotheria*, *Litopterna*—and the principal constituents of the fauna are immense numbers of *Edentates*, *Marsupials* and *Rodents*, with several platyrrhine monkeys. No artiodactyls, perissodactyls, proboscidians, Condylarthra or Amblypoda, neither Insectivora, Cheiroptera, Carnivora or Creodonta are known. The Edentates are all of the specifically South American type, sloths, armadillos and the like. The Rodents also are very much like those which still characterize the region, though most of the genera are distinct; they are all Hystricomorpha, neither squirrels, marmots, beavers, rats or mice, hares or rabbits occurring among them." (SCIENCE, February 28, 1896, 308.)

The total absence of the early South American types from the rich deposits of vertebrate fossils in the United States, and the corresponding absence of North American types from all but the later fossil beds of South America, prove clearly, as Mr. Lydekker says, that "there must have been a barrier between North and South America during the Oligocene and a portion or the whole of the Miocene." Scott has already told us that "in the Pliocene (Monte Hermoso) appear the first traces of the union with North America, in the presence of mastodons, horses, tapirs, deer, llamas and true carnivores, and from that time till far into the Pleistocene the intermigrations between the two continents kept up until a large number of common types had been established." Lydekker, speaking of the same event, says: "The presence of a glyptodont in the Nebraska stage of the Loup-Fork group in North America, and of northern forms in the Monte Hermoso horizon of South America, marks, then, the first commingling of the original faunas of the two halves of the New World. For the first time in the history of the southern continent this connec-

tion allowed of the immigration from the north of the true Carnivora, such as the existing cats (*Felis*), the extinct sabre-toothed tigers (*Machærodus*), dogs and foxes (*Canidæ*), bears (*Ursus* and *Arctotherium*), raccoons (*Procyonidæ*), skunks and their allies (*Mustelidæ*), together with various ungulates belonging to suborders previously unknown in the realm. These latter include the guanaco and vicuña (*Lama*), of which ancestral forms are abundant in the North American Tertiaries, New World deer (*Cariacus*), horses (*Equidæ*) of various genera, tapirs (*Tapiridæ*), peccaries (*Dicotylidæ*) and mastodons. Among the rodents, squirrels, the various genera of *Muridæ* and the hares, likewise at this epoch made their first appearance on the scene. Opossums also at this time effected an entrance into the land which has now become their chief home." (Pp. 119–120.)

Having arrived at the conclusion that the Pliocene and present mammal faunas of South America came from North America, and that the earlier faunas could not have been derived from the same source, Mr. Lydekker seeks to account for the origin of the latter. This, he freely admits, "is a difficult and perplexing subject which it is scarcely possible to explain fully in the present imperfect state of paleontological knowledge." Still, he agrees with Scott, Neumyr and others in the belief that the evidence points strongly to an early land connection with Africa and also with Australia. In the case of certain Patagonian marsupials he finds it difficult to come to any conclusion other than that their ancestors "reached the country from Australia, either by way of the Antarctic continent or by a land bridge in a more northern part of the Pacific." Continuing, he observes: "If this be correct, and likewise the supposition that the opossums originated from the ancestral stock in southeastern Asia, it will be evident that *Didelphys* and *Cænolestes* met in South America after their ancestors had travelled half around the world in opposite hemispheres."

Mr. Lydekker is evidently disturbed by his inability to define to his own satisfaction the Mediterranean region—the analogue of our Sonoran. He speaks of it again and again, but not always in the same way. Thus is one place (p. 310) he says: "Could a Mediterranean region be satisfactorily defined, the homogeneity of the mammalian Holarctic fauna would be still more apparent; but this, from the great mingling of northern and southern types which has taken place in the Old World, is, I think, impracticable." Again: "The Mediterranean or Tyrrhenian sub-region has strong claims to be regarded as representing a region by itself" (357). I have no doubt that sooner or later some enterprising naturalist will make a detailed study of this region, tabulate its distinctive genera and define its tortuous boundaries.

While it is not the purpose of the present review to criticise technical points in classification, one cannot help wondering on what characters the statement is based that the sewellels (*Aplodontia*) are 'closely allied to the squirrels.' On the other hand, it is pleasing to note that the aard-varks and pangolins are separated from the Edentates proper and given independent ordinal rank, under the name *Effodientia*. The lemurs are retained among the Primates—the usual and conservative course. Prof. Hubrecht has recently shown that the embryology and placentation of the Lemuroidea indicate that these animals are entitled to rank as an independent order, and that *Tarsius* is not a Lemuroid at all, but the earliest known Primate. He finds that the fossil genus *Anaptomorphus* of Cope is intermediate between *Tarsius* and the higher Primates, while *Tarsius* itself looks back to an ancestry suggesting the genus *Erinaceus* of the heterogeneous order Insectivora. Prof. Wilhelm Leche, from a study of the teeth, arrives at somewhat different conclusions.

The interesting and highly important subject of the geographic 'centers of evolution' is dismissed with a single page, where it is handled gingerly and in general terms only. In view of the standpoint from which the book is written —that of the paleontologist—it seems as if a chapter had been omitted—a chapter on the centers of origin, in time and space, of the different groups of mammals. Much information of this kind is scattered through the book, but it would be exceedingly convenient to have it epitomized by groups.

Evidences of haste in the preparation of Mr. Lydekker's book crop out here and there, par-

ticularly in the case of contradictory statements on different pages. For instance, on page 87 it is said that the Sonoran family *Geomyidæ* has only two genera (inferentially *Geomys* and *Thomomys*), while on the same page the genus *Heteromys* is added, and on a later page (366–7) no less than seven genera are enumerated as included within the family! Again, on page 342 it is stated that no member of the family *Geomyidæ* is found within the limits of the Holarctic region, while on page 366 we are told that the genus *Thomomys* of this family 'penetrates into the Canadian sub-region of the Holarctic.'

Lack of personal familiarity with the geographic distribution of living mammals in North America, and carelessness in examining current literature, have led to a number of additional errors. For instance, the genus *Spermophilus* is said to be restricted to the 'Holarctic' (= Boreal circumpolar) region, whereas we have one Tropical and at least a dozen Sonoran species, and two well marked Sonoran sub-genera. Again, the lynxes are said to be 'absolutely confined' to the Holarctic, while in the United States they range throughout the Sonoran and south into Mexico. *Zapus* also is said to be 'solely Holarctic,' although it is common as far south as the city of Washington. In the case of the rabbits it is stated that the greater number of species are Holarctic. In America the contrary is true, the greater number being Austral or Sonoran. We are told that *Notiosorex*, a genus of shrews, ranges south to Central America, but it is unknown from any point south of Mazatlan, in Mexico. Similarly the raccoons (genus *Procyon*) are said to occur 'over most parts of North and South America,' but in North America they are absent from the northern half of the continent.

The book is well printed and some of the illustrations are good; others, as, for instance, that of the tree-shrew (Fig. 61), look as if they might have been exhumed from the tombs of the ancients.

The work deserves a critical review from the paleontological side by some one competent to speak from the American standpoint. Then a revised and corrected edition should be brought out, for in spite of its imperfections, the book is probably the most useful contribution ever made, at least in the English language, to the subject of the distribution of the Mammalia, living and extinct. C. Hart Merriam.

The Elements of Electrochemistry. By Max Le Blanc. Translated by W. R. Whitney. Pp. x+284. New York, The Macmillan Company. 1896. Price, $1.50.

This volume is the English version of Le Blanc's *Lehrbuch der Elektrochemie*, which was published at Leipzig in the early part of this year.

The original met with a cordial reception, and this translation certainly deserves a warm welcome at the hands of those who are interested in the subject of which this book treats, but who are unable to consult it in the language in which it was written.

It has been the author's intention, averred in his preface, to 'write as clearly and simply as possible.' In this he has certainly succeeded.

The opening chapter brings an introduction to the fundamental principles of energy in general, and electricity in particular, which is most logically and lucidly written.

Next comes a chapter containing a brief but well balanced history of the development of electrochemistry up to the present time, and then follow able presentations of the Arrhenius theory of dissociation, the migration of the ions, the conductivity of electrolytes, electromotive force; a discussion of galvanic elements and accumulators forms the concluding chapter.

A careful persual of this treatise will certainly place its reader in possession of a clear and comprehensive view of the present state of this important subject—electrochemistry.

Comparison with the original shows the translation to be well done and fluent; the translator having wisely avoided too close an adherence to the author's style, which at times is a little ponderous.

Omission, in the English book, of the plus and minus signs, used by Le Blanc to specify the two kinds of ions, is to be regretted. On the other hand, valuable features introduced by the translator are the subject-index and the list of authors' names.

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SCIENTIFIC JOURNALS.

THE AMERICAN JOURNAL OF SCIENCE.

THE January number, beginning Volume III. of the Fourth Series, opens with an article on the *Worship of Meteorites*, by the late Prof. Newton. This article was delivered as a lecture in New Haven some eight years since, but has not before been published. In it the author has brought together a large number of facts showing the superstitious regard attached to meteorites from the very earliest times. The first case mentioned is that of the iron from an altar of an Indian mound in Ohio, which was preserved with other articles evidently regarded as of peculiar value. By some this iron is regarded as probably the same as that of which a number of masses were found about 1886 in Kiowa county, Kansas. Another case spoken of is that of the stone which fell at Ensisheim, in Alsace, in 1492, which was preserved in a church at that place. A fall of stones some nineteen years later near Milan, in Italy, is also alluded to as having probably been the occurrence recorded by Raphael by the fireball in his picture of the Foligno Madonna now in the Vatican. The sacred stone of the Mohammedans preserved in the Kaaba of the mosque at Mecca is also mentioned as perhaps a case in which a meteorite has been selected for long continued worship. The author then goes on to discuss a number of instances recorded in classical literature, and, although it is impossible to say that in each case a meteorite was the object described, in many cases it seems highly probable. The Palladium of Troy, the Needle of Cybele, the original image of the Ephesian Artemis, are some of the cases which the author describes in detail with quotations from the original authorities. On a later page of the same number a description is given by Warren M. Foote, of a new meteoric iron from the Sacramento Mountains, in New Mexico. This is a typical siderite and weighed, as found, 237 kilograms (521 pounds). It shows the common octahedral structure with unusual distinctness. Two plates accompany the article, one showing the appearance of the iron itself, one-eighth the natural size, the other the Widmannstätten figures printed directly from an etched slab. As further bearing on the same subject is to be mentioned a catalogue of the meteorites in the Yale University collection, which forms an appendix to the number.

The second article is by John Trowbridge and and T. M. Richards, on the *Spectra of Argon*. The authors have studied these spectra, the first one of which is characterized by red lines, and the other by blue, by means of a high tension accumulator giving an electromotive force of over 10,000 volts. The advantages of such a source of electricity of high potential as contrasted with the ordinary induction coil the authors found to be very great. By means of it they were able to study minutely the conditions under which each of the spectra mentioned was obtained. The argon employed was a sample of exceptional purity obtained from Lord Rayleigh, and the tube containing it was prepared with special reference to the work in hand. The authors found that the red glow in the tube was due to a unidirectional discharge, while the blue glow was due to an oscillatory discharge; the conditions determining the change of the red to the blue glow are described in detail. It appears that an argon tube is extremely sensitive to oscillatory discharges, and it is suggested that it is likely to be of great use, on this account, in the study of wave motions of electricity.

George F. Becker discusses at length the hypotheses which have been advanced to explain the differentiation of rock magmas. The segregation of a homogeneous fluid into distinguishable portions has been regarded as due to molecular flow, as is shown in ordinary diffusion or in osmosis. All the processes of molecular flow are shown to be reducible to the movements which are due to differences of osmotic pressure. The most important case of molecular flow as regards the subject under discussion (studied by Soret) is that due to the heating of the solution at the top; this, however, requires a very improbable decrease of temperature with the depth. Furthermore, when the rate of diffusion in two miscible liquids in contact is discussed quantitatively, assuming a rate of diffusion such as that already determined for copper sulphate, it is shown that this rate is *extremely slow*. Thus, in the case of copper sulphate and water in contact, at the expiration of a million years the

water would be sensibly discolored at a distance of 350 meters, while semi-saturation would have been reached only at a distance of 84 meters. When the relatively high viscosity of lava is taken into account, assumed by the author as more than 50 times greater than that of water, the rate is found to be still slower; and consequently a sensible impregnation of the lava would extend in a million years to only about 49 meters from the surface of contact. Further than this, it has been shown that convection would be to some extent unavoidable, and, so far as it acted, it would tend to destroy this action of diffusion. Segregation by the separation of the magma into immiscible portions is regarded as the least objectionable method, "but this seems to involve a superheated, very fluid magma, while the law of fusion and the distribution of phenocrysts in rocks indicate that magmas prior to eruption are not superheated to any considerable extent and are very viscous." The author concludes that "the homogeneity of vast subterranean masses called for by the hypothesis of differentiation is unproved and improbable. The differences between well-defined rock types are more probably due to original and persistent heterogeneity in the composition of the globe. Hypogeal fusion and eruption tend rather to mingling than to segregation, and transitional rock varieties are not improbably mere fortuitous mixtures of the diverse primitive, relatively small masses of which the lithoid shell of the earth was built up."

H. S. Washington describes a series of igneous rocks from Asia Minor. These include some augite-andesites from Smyrna and a biotite-dacite from Pergamon. The microscopic characters are given in full, and also a number of analyses. M. Carey Lea mentions an experiment obtained from a solution of chloride of gold, containing 1 gram to 10 cc., combined with a 10% solution of sodium hypophosphite. The result is a solution of deep green color, which is shown to be due to the presence of a small quantity of gold in its blue form, in a state of very fine diffusion, which, together with an undecomposed solution, gives the effect of green. A. E. Verrill and Katherine J. Bush discuss at length a revision of the genera of Ledidæ and Nuculidæ of the Atlantic Coast of the United States. The authors state that a somewhat extended study of the series of deep-sea bivalves belonging to these families, dredged off our coast by the U. S. Fish Commission, from 1872 to 1887, has compelled them to revise the known genera and subgenera and to propose several new groups. In view of an unexpected delay in the publication of the report upon these families, which had been completed and fully illustrated, it has seemed desirable to them to publish a brief preliminary account of the classification adopted. The present article is the result. Two plates with twenty-two figures show typical forms with details of the hinge structure. The number closes with the usual abstracts, book notices, an obituary notice of Dr. B. A. Gould, etc.; a note is given to the remarkable meteor of December 4th; also a brief account of a gigantic squid formed on the coast of Florida.

SOCIETIES AND ACADEMIES.

BOSTON SOCIETY OF NATURAL HISTORY, BOSTON, MASS.

A GENERAL meeting was held Wednesday, November 18th, 290 persons being present. An account of the work of the Boston party accompanying the sixth Peary expedition to Greenland was given by Messrs. Barton, Burton and Porter.

Prof. G. H. Barton gave a narrative of the line of travel and of the general points of interest noted during the exploration, describing with some detail the character of the inland ice and the structure and work of the glaciers in the Umanak district.

Prof. A. E. Burton described the topographic barrenness of the Umanak district; the abundance of boulders and the stunted growth of the trees was everywhere apparent. With the aid of maps thrown on the screen he showed the stations where magnetic observations were needed, and described at length the results of the magnetic and pendulum work done on the coast of Labrador, on the north shore of Hudson Straits, and in the Umanak district. Prof. Burton gave a detailed account of his study of the Karajak glacier; the motion of this and of other glaciers was carefully measured. An average of 19 feet in seven days was noted and an interesting observation con-

nected with the flow of a glacier up stream was explained by the action of a strong return eddy. The temperature of the air, water and ice in glacial crevices was also carefully recorded. Never to follow streams and never to return except by the way of coming, were given by Prof. Burton as two axioms for travelers in Greenland.

Mr. R. W. Porter gave an account of his sketches of ice structure and of his water colors of the natives.

Stereopticon views illustrated the remarks of all the speakers. SAMUEL HENSHAW,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 255th regular meeting of the Anthropological Society was held Tuesday evening, December 15, 1896. A paper read by Mr. George R. Stetson under the title 'The Eye, the Ear, and the Common Weal of Whites and Blacks,' was a résumé of the literature of eye and ear examinations, including the one made in the Washington schools last winter by Drs. Belt, ophthalmologist, and Eliot, otologist, of 500 white and 500 black children in the 4th and 5th grades of the average ages of 11 and 12.56 years.

The points emphasized in Mr. Stetson's paper were: the prevailing ignorance of the normal power of these organs and their consequent neglect by the 'intelligent' and 'ignorant' classes alike; the gross carelessness of both these classes, even when the defects are known; the importance of systematic and accurate school examinations in discovering defects impossible to remedy in later life, in correcting erroneous and disastrous opinions as to the intellectual capacity of children who have defective eyes or ears, in detecting eye strain or abnormal innervation of the eye muscles, etc., etc., and in the determination of the future occupations of those seriously affected; the great economic value of these tests in the prevention of pauperism and in reducing the number of expensive public institutions.

Mr. Stetson asserted that not a single one of our State Boards of Health or Education had ordered systematic observations, which have been thoroughly made in Germany and elsewhere for several years, also that while the data obtained serve the admirable purpose of pointing out the general neglect of these organs, and of showing the importance and necessity of greater attention to their defects, they failed to be of any great value for general or comparative purposes, because of the absence of uniformity in the methods employed in testing, of periodical examinations and in the ages of those examined, etc. Perhaps most important and convincing evidence of the humanitarian and economic value of such examinations, the writer thought is found in the ignorance and indifference developed by the Washington inquiry, especially in the lower classes. Among the Blacks, of all eyes classed as 'Extremely defective,' 'Very defective' and 'Defective,' 43% were unknown either to parent, teacher or scholar. Of the 'Extremely defectives,' or those with less than one-tenth normal vision, 22.50% were equally unknown. Of the ears of the Blacks, 57% were similarily unknown, and of those having but one third normal hearing, 55%. Among the whites the record is better.

Of all 'defective' eyes, 34.28% were unknown to all, and of all 'defective' ears, 2% were unknown. The examination also disclosed the fact that, with the knowledge of the existing defects, the instances were very rare in either race or social condition in which the persons were under treatment. Otologists and ophthalmologists were shown to be in accord in the opinion that even a partial defect in hearing or in sight will find expression somehow in the mental development, or, put in a different way, that the diminution in mental development will correspond closely to the degree of the visual or aural defect. They are also in accord in the belief that the eye and the ear can be trained and educated to a much higher power than they now possess, or allowed to become atrophied by neglect or lost by abuse. The details of the Washington examination show very slight racial differences. The visual defects were 3.46% greater in the Blacks, the aural defects being equally divided. The difference in the sight and hearing of the right and left eye and ear was very slight in either race, while the maximum percentage of defective eyes of both races was found in the white female. In the Whites the female eye and ear are both the

most defective; in the Blacks the female has the most defective eye and the male the most defective ear. The result of Mr. Stetson's memory test of the same number is reserved for another paper.

A paper by Surgeon-General Geo. M. Sternberg was read, entitled 'Science and Pseudo-science in Medicine,' in which he noted the difference between the truly scientific investigations, with special reference to preventive medicine, in contagious and infectious diseases, and the great service such investigations had been in stamping out epidemics such as cholera, yellow fever, etc., and the so-called science of pretenders and frauds for the sake of gain. He then dwelt at some length on the arrant quackery, charlatanism and fraud practiced by the promoters of numerous well advertised cure-alls which, by plausibly used scientific terms and facts, were calculated by their pretended science to mislead and deceive. This gave rise to an interesting discussion upon the desirability of government supervision and interference in the publication in the press and the sale of such preparations. Messrs. McCormick, Ward, Stetson, Pierce, Farquhar, Blodgett and others took part in the discussion.

J. H. McCormick,
Secretary.

TORREY BOTANICAL CLUB.

At the meeting of Tuesday evening, December 8th., thirty persons were present and one new active, and seven corresponding members were elected. The death of Mr. Wm. H. Rudkin, one of the oldest members of the club, was announced by Dr. Britton and a committee was appointed to take suitable action. It was resolved that a complete list of the corresponding members should be printed in the December number of the *Bulletin*. A contribution by Dr. T. F. Allen, entitled 'Descriptions of New Species of *Nitella* from North America and Japan' was read by title by Dr. Britton, in the absence of the author. Mrs. Elizabeth G. Britton presented a 'Contribution to the Bryology of Bolivia.' It reviewed the more important collections of Bolivian mosses, the treatment which they had received and the present work in progress on this subject, and enumerated the bryological collections made by Dr. Rusby in Bolivia in the years 1885 and 1886. This collection contained 96 species, in 39 genera, 42 of the species being hitherto undescribed. Dr. H. H. Rusby spoke of 'Botany at the Pan-American Medical Congress held in the City of Mexico, November, 1896.' This paper contained brief references to the character of the flora observed on the journey to Mexico, an account of the scientific progress in the city, especially pertaining to applied botany and referred to the botanical work organized by the Pan-American Medical Congress. It was supplemented by remarks upon the same subject by Mrs. Britton, who also attended the Congress. A number of important publications by the *Instituto Medico Nacional* were exhibited. Dr. N. L. Britton described a new species of Geranium hitherto confounded with *G. Carolinianum*. The papers by Dr. Allen and Dr. and Mrs. Britton will be published in the *Bulletin*, that by Dr. Rusby in the *Druggists' Circular*. On motion the Club adjourned to meet on the second Tuesday in January.

H. H. Rusby,
Recording Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of St. Louis on the evening of December 21, 1896, Mr. H. von Schrenk made some remarks on the parasitism of lichens, illustrated especially by the long hanging forms of *Usnea barbata*, common on *Juniperus*, etc., on Long Island, N. Y. It was shown that these lichens do not penetrate below the outer periderm of the host, and consequently are not to be regarded as true parasites, but that they frequently cause the death of the latter by suffocation. As Schimper has noted for the long moss of the South, *Tillandsia usneoides*, the plant is capable of dissemination by wind and birds, and of growing in new stations without attachment.

Officers for 1897 were nominated.

Wm. Trelease,
Recording Secretary.

Erratum: Prof. H. A. Hazen calls our attention to the fact in our letter from M. W. de Fonvielle on page 762, Hersuite should be Hermite and 60,000 m. should be 15,000 m.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, JANUARY 8, 1897.

CONTENTS:

The Smithsonian Institution and the National Museum..... 37

The Geology of Government Explorations (concluded): S. F. EMMONS..... 42

Professor Eugen Baumann: LAFAYETTE B. MENDEL..... 51

Alfred Tresca: R. H. T..... 53

Current Notes on Anthropology:—

Ancient Mayan History; Primitive Drills and Drilling; The State and its Soil: D. G. BRINTON.. 53

Scientific Notes and News:—

The Davy-Faraday Research Laboratory; The Marine Biology of Great Britain; General..... 54

University and Educational News..... 59

Discussion and Correspondence:—

Clouds over a Fire: R. DEC. WARD. *Compliment or Plagiarism*: BEMAN AND SMITH. *Volcanic Dust in Southwestern Nebraska and in South Dakota*: J. E. TODD..... 60

Scientific Literature:—

Beal's Grasses of North America: F. LAMSON-SCRIBNER. *Hoffmann on Race Traits and Tendencies of the American Negro*: W J MCGEE. *De Ujfalvy on Les Aryens au Nord et au Sud de l'Hindou-Kouch*: D. G. BRINTON..... 62

Scientific Journals:—

The Monist..... 69

Societies and Academies:—

The New York Academy of Sciences:—*Section of Astronomy and Physics*: W. HALLOCK. *Section of Biology*: C. L. BRISTOL. *The American Chemical Society*: DURAND WOODMAN. *Boston Society of Natural History*: SAMUEL HENSHAW. *The Alabama Industrial and Scientific Society*: EUGENE A. SMITH..... 70

New Books..... 72

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE SMITHSONIAN INSTITUTION AND THE NATIONAL MUSEUM.

THE great loss to science in the death of George Brown Goode is becoming every day more apparent and especially in view of the difficulties by which the Regents of of the Smithsonian Institution must find themselves confronted in the selection of his successor as Assistant Secretary.

Under the existing relations of the Institution and the National Museum, and the accepted traditions relating to succession, the task must seem well-nigh impossible. While the present situation may not be considered as a crisis in the affairs of the Smithsonian Institution, it cannot be improper for SCIENCE to invite the attention of its readers, and especially of the Regents, to a feeling on the part of a large number of its friends that the time has come for a more or less complete separation of the two organizations and that such separation in the near future ought to be assumed in selecting a successor to Goode.

The reasons for this are so numerous and so convincing, when once the Smithson bequest and its interpretation by Joseph Henry are considered, that argument seems unnecessary. It may be well, however, to refer to a few of the more important points,

and especially to show that the existing condition was not approved by those who guided the Institution through the dangers by which it was beset during its earlier years and to whom we are indebted, more than to all others, for the splendid work which it has accomplished during the first half century of its existence.

The origin of the Smithsonian Institution was singular, its organization is unique and its success has been unparalleled. In 1796 Washington recommended as of primary importance the promotion of '*institutions for the increase and diffusion of knowledge.*' In 1826 James Smithson, an Englishman about whom America knew nothing and who knew practically nothing of America, wrote in his will: "I bequeath the whole of my property to the United States of America, to found at Washington an establishment for '*the increase and diffusion of knowledge among men.*'" In 1846 John Quincy Adams wrote: "Let the trust of James Smithson to the United States of America be faithfully executed by their Representatives in Congress; let this result accomplish his object—*the increase and diffusion of knowledge among men.*"

As soon as the funds resulting from the bequest of Smithson were in the treasury of the United States a multitude of plans were suggested for the realization of the intention of the donor. Some were reasonable, many were unreasonable, and it is now universally conceded that the scheme of organization proposed by Joseph Henry and adopted by the Board of Regents was the best that could have been selected. The essence of that scheme is most clearly exhibited in the words of Prof. Asa Gray, who wrote: "Henry took his stand on the broad and ample terms of the bequest, 'for the increase and diffusion of knowledge among men,' and he never narrowed his mind and to *locality* gave what was meant for mankind. He proposed only one restriction, of wisdom and necessity, that in view of the limited means of the institution, it ought not to undertake anything which could be done, and well done, by other existing instrumentalities. So, as occasion arose, he lightened its load and saved its energies by giving over to other energies some of its cherished work." It is through this policy that the Institution has enjoyed a career of usefulness unequalled by that of any similar organization, and in Prof. Gray's words will be found the strongest arguments against a continuation of its existing relations to the National Museum. By the terms of Smithson's will the Institution is charged with two functions: The *increase* of knowledge, and its *diffusion* among men. To both of these should be applied the principle of restriction so wisely adopted by its first Secretary, that it ought not to undertake anything that could be done, and well done, by existing instrumentalities. It has, therefore, under each of its distinguished directors, increased knowledge by aiding original investigators who were otherwise unable to carry on their researches, and it has diffused knowledge among men by publishing many important memoirs, translations, summaries, etc., which would hardly have been made available without such assistance. Its extensive system of international exchanges has been in the same line, and in all this its position has been unique.

In the earlier years of the Institution its collections were such as related purely to research and were made in the course of various original investigations to which it was giving aid. These naturally increased in number and covered an increasingly large field, though mostly pertaining to the biological sciences. Although no special effort was made to arrange them for public display, they constituted an interesting collection, and a visit to the 'Smithsonian' was accounted an essential incident in a pilgrimage to the Nation's capital. It then came to be considered as in some sense a 'museum.' What is known as the 'National Museum' was established by the Government in 1842, being made up largely of specimens collected by the Wilkes expedition. It was housed in the Patent Office, but in 1858 it was transfered to the Smithsonian Institution, being largely increased at that time by additions from other government departments. Its acceptance then by the Institution was undoubtedly in furtherance of the idea that it ought to undertake what evidently could not have been accomplished by any other organization, namely, the consolidation of the numerous collections that had separately grown up in the several departments. That it was not expected that the Institution should permanently load itself with museum management is clear from the attitude of its authorities twenty years ago. In his Report to the Regents for the year 1876, Prof. Henry puts the whole matter so clearly that his words may well be quoted in part. He says: "I may further be allowed to remark that the experience of the last year has strengthened my opinion as to the propriety of a separation of the Institution from the National Museum. * * * Smithson gave *his own* name to the establishment which he founded, thereby indicating that he intended it as a monument to his memory, and, in strict regard to this item of his will, the endowment of his bequest should be administered *separate from all other funds, and the results achieved by it* should be *accredited to his name alone*. The Institution should not, therefore, be merged in an establishment of the government, but should stand alone, free to the unobstructed observation of the whole world, and keep in perpetual remembrance the name of its generous founder. * * * Every civilized government of the world has its museum, which it supports with a liberality commensurate with its intelligence and financial ability, while there is but *one Smithsonian Institution*—that is, an establishment having expressly for its object 'the increase and diffusion of knowledge among men.' The conception of such an institution—not a local establishment intended to improve the intellectual condition of any single city or any single nation, but that of mankind in general—was worthy of the mind of Smithson, and the intelligence and integrity of the United States are both involved in the proper administration of the trust, since the terms in which it was conveyed must be truly interpreted and the intention expressed rigidly carried out." Prof. Henry continues in reply to the assumption sometimes made that the Institution was benefited by increased popularity due to its connection with the Museum, declaring that, on the contrary, this connection has proved a serious obstacle in the

way of the full development of the plan of the Institution, and naming as the most objectionable result the necessity for constant appeals to Congress for appropriations, which would be quite unnecessary if its energies were confined to their legitimate channels.

In his Report for 1887 Prof. Henry said: "In the preceding reports I have called the attention of the Board of Regents to the propriety of a final separation of the Institution from the National Museum, and nothing has occurred during the past year to change my opinion on this point. * * * The functions of the Institution and the Museum are entirely different."

In a report of a special committee submitted in 1887 by Prof. Asa Gray, then a Regent of the Institution, the question is seriously considered and the dangers by which the Smithsonian Institution is menaced through its relations to the National Museum are set forth, in part, as follows:

"We are therefore bound to conclude that the Board of Regents, as respects these National collections, acts as the trustee of Congress. Under this state of things, and in view of the ever-increasing magnitude and interest of these collections, the relation of this Institution to the National Museum becomes a matter for grave consideration. * * *

"Our Secretary, in his annual report submitted on the 26th of January, 1876, has now raised the grave question whether the well-being of the Institution would not favor or even require the adoption of a similar policy as regards the National Museum. He declares that it is most 'desirable that a more definite distinction between the two establishments, if not an entire separation, should be made,' and he urges the subject upon our attention by considerations which cannot be disregarded. Your committee was appointed to take thought upon this subject. The vast increase of museum objects in natural history, ethnology, and materials of industrial art, consequent upon the Centennial Exposition, an increase far beyond the largest anticipations, gives new importance and urgency to this question. * * * Now the proportion which the Museum bears to the Institution proper is already large, and it threatens to be predominant. We have no desire to check its immense development, and we contemplate with satisfaction its sure popularity; but as respects the burden which the Museum throws upon our Secretary, we may say that it is already heavy, and that it threatens to be injuriously large. If not provided against, the time seems sure to come when the Museum will mainly absorb the working energies of the Institution. * * *

"No present action is proposed by this committee beyond the recommendation that the distinction between the Institution itself and the Museum under its charge should be made as prominent as possible. The very great development which the Museum is now undergoing may soon bring the whole subject before the board in a practical form * * * if the Museum is to develop to its full size and importance upon the present site, according to the plans laid before the board, and by it recommended to Congress this will, as it seems to us, almost necessarily involve the acquisition by the government of our present edifice, and that will pave the way for an entire separation of administration, or to such other adjustment as the Board of Regents may then think best, or be able to accomplish." [Signed]

Asa Gray,
A. A. Sargent,
Hiester Clymer,
Committee.

Although Prof. Baird was naturally more interested than his predecessor in the development of the Museum, of which he was, indeed, for many years Curator, his recognition of its independence of any real relation to the Institution was shown in his first report to the Regents, being that for the year 1878. He says: "The relations existing between the Smithsonian Institution and the National Museum have been so frequently referred to by my predecessor that it is only necessary to mention briefly

that the Museum constitutes no organic part of the Institution, and that, whenever Congress so directs, it may be transferred to any designated supervision without affecting the general plans and operations connected with the 'increase and diffusion of knowledge among men.'"

There is another and most serious objection to the present organization which is, in a degree, personal in its nature. There is an approved tradition that the Assistant Secretary shall, on the occurrence of a vacancy, succeed to the Secretaryship, and the latter should, in the best interests of science, be held alternately by representatives of the two great divisions of science, physical and biological. It will almost invariably happen that the naturalist only will have any special taste or fitness for museum work, and upon him, then, both as Assistant Secretary and Secretary, this burden will fall. If he is chosen for his experience and skill as a museum director, he may fail as a Secretary of the Institution if he should in time succeed to this high office, for we may not expect to find many such men as Goode, who, in a remarkable degree, combined the qualities necessary to a successful administration of both functions. On the other hand, one selected with a view to his eventually being a worthy successor to the distinguished men who have thus far guided the destinies of the Institution may not be a good museum administrator.

Finally, the whole may be put in two or three simple propositions. There is no logical connection between the Smithsonian Institution and the National Museum. The Museum is a most important institution, it is now well established, its maintainance is demanded by the people, and it will thrive under a competent director, responsible only to Congress or to the head of some department under which it could properly be placed. The usefulness of the Smithsonian Institution will be increased by the diminution of burdensome administrative duties which were never contemplated in its original scheme, and for the existence of which there can be no reasonable excuse. Its legitimate work is too important to be interfered with by demands which can be met in ordinary channels, and if such wide departures from its early policy continue to be forced upon it by ill-considered legislation, there is reason to fear that its splendid career during its first half century will not be repeated in the second.

In conclusion it ought to be said that in the above it is not intended to reflect the views of the present distinguished head of the Institution or of any of its officers. We are quite ignorant as to what these views may be, nor do we wish to be understood as criticising, in the slightest degree, the present admirable administration of the Institution or of the Museum. There are doubtless valid arguments, such as the danger that the Museum might fall among politicians, which could be urged for the continuation of the present arrangement. Still we believe that, for the reasons recorded, the interests of both institutions and the interest of science throughout the world would be furthered by a separation of the two organizations. If the regents are strongly of the opinion that the danger of political intermeddling is too great to justify a complete severance of existing relations at this time,

it is at least possible to select an Assistant Secretary in accordance with the theory outlined above, and a Director of the Museum possessed of special qualifications for that work, and who shall, of course, be subordinate to the Secretary of the Institution. This might lead the way to what is certainly still more to be desired.

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*THE GEOLOGY OF GOVERNMENT EXPLORATIONS.**

GEOLOGICAL EXPLORATION.

During the Civil War all scientific exploration in the West under the auspices of the government was suspended, and it was not until the summer of 1867 that it was resumed. By this time far-sighted men had come to appreciate the political importance of a more exact geological knowledge of the region between the Mississippi Valley and the Sierra Nevada. During the war there had been no little danger that the States of the Pacific slope might secede from the Union and form a republic of their own, isolated as they were from the other States by a barrier of 1,000 to 1,500 miles of comparatively uninhabited mountains and desert valleys. The lending of government aid to the building of a trans-continental railroad, which had already been decided on, was the first step toward removing this barrier and drawing the peoples of the East and the West into closer connection. The second step was to encourage the settlement of this intermediate region by making known to the public its rich and varied mineral resources. Hence, Congress showed itself ready to lend an ear to geologists who were desirous of getting government aid to carry on geological researches in the comparatively unknown region beyond the mountains.

Now, for the first time, explorations beyond the Missouri river, or surveys, as they soon came to be called, were fitted out avowedly for the purpose of geological investigation, instead of being primarily organized for geographic or military purposes and admitting researches into geologic and other branches of natural history as a sort of ornamental appendage of their work. For the first time also were they under civilian control instead of military discipline and command. During the twelve years previous to the organization of the present Geological Survey the principal geological work in the West was done under four district organizations, popularly known from the names of their leaders as as the King, Hayden, Powell and Wheeler Surveys. The official control of the first and last was under the Chief of Engineers of the United States army, but only the last was commanded in the field by military officers. The other two were under the Interior Department and their official titles changed somewhat with the development of their work.

During this period geologists were also attached from time to time to military reconnaissances, but with one exception—that of Newton and Jenny in the Black Hills, where the geological information had a political bearing—the march was so rapid that the opportunities of geological research were very limited, and the results of relatively little importance. Therefore, in view of the limited time at my disposal, I shall confine myself mainly to the principal surveys above mentioned.

Before commencing an account of their methods and work accomplished it will be well to pass in review the condition of geological knowledge of the country west of the Mississippi Valley at the commencement of this period in 1867.

No areal work, in the sense in which it is understood to-day, had been commenced or hardly thought of. The only maps that

* Concluded from the issue of January 1st.

existed were those giving the general features of the larger drainage systems on which was no connected or systematic representation of the surface features; in certain limited areas the relief was sketched in by hachures, or, as in Egglofstein's maps, by delicate shading.

On the Great Plains it was known that Mesozoic and Tertiary formations formed the greater part of the surface, and the Cretaceous rocks had been divided by Meek and Hayden into five subdivisions. Around the Black Hills, Lower Silurian and Carboniferous rocks had been identified. Carboniferous limestones were known to have a considerable extension in the interior region in middle and southern latitudes, and to have been seen in the northern part of the Sierra Nevada. The age of the upheaval of the latter range had been determined to be post-Jurassic, by the discovery by Clarence King, of the State Geological Survey of California, of Jurassic fossils in the auriferous slates. It was conjectured, reasoning from their association in the Black Hills, that Silurian beds would ultimately be found associated with the Carboniferous, but the discovery of Devonian fossils in central Nevada by Engelmann in 1859 had not yet been made public. It was known in a general way that igneous rocks, granites and metamorphic rocks were widely distributed throughout the interior, but of their mutual relations, or the actual structure of the mountain ranges, there was little but surmise, and not very much of that.

As regards the physical conditions of the interior, although the region east of Salt Lake was known to be well watered, in the desert region of the Great Basin to the westward, it was not supposed that campaigning was possible, except along certain lines of emigrant travel, and on these it was known that there were inconveniently long stretches without water.

King Survey. The Geological Exploration of the 40th Parallel, as it was officially known, was entirely the creation of its chief, Clarence King. The first conception of the feasibility of making a geological cross section of this, the longest mountain system in the world, at its widest part, had come to him during his long three months' journey with an emigrant train from Missouri to the Sierra Nevada, which he undertook in the summer of 1861. His personal influence had, during the winter of 1866–7, secured the passage of a bill through Congress creating the 40th Parallel Survey, whose duty it was to examine into and report upon the geology and mineral resources of the country to be opened up by the Pacific railroads. At his suggestion it was placed under the official direction of Gen. A. A. Humphreys, Chief of Engineers, in whose scientific ability he had the greatest confidence.

His plan of work contained much that was novel and startling, especially in consideration of the desert character of the region in which it was to be carried out. This plan contemplated making a topographical map of the region surveyed, not simply a map of meander lines, with sketches in hachures of the hillsides, which was the only form of relief map known at that time, but a contour map on the same general plan with the Survey maps of the present day, controlled by systems of primary and secondary triangulations, the relative elevations to be determined by frequent observations of cistern barometers. The scale adopted was four miles to the inch. Besides the usual botanical and zoological assistants, an excellent photographer was attached to the party. The area to be surveyed, which was always to include the line of the projected railroad, was divided into rectangular blocks or atlas sheets, about 165 miles in length by over 100 miles in width. The original plan contemplated

three, but ultimately five of such blocks were surveyed.

The party rendezvoused in California in the early part of the summer of 1867, and commenced work at the east base of the Sierra Nevada in August of that year, with J. D. Hague, Arnold Hague and S. F. Emmons as geological assistants to Mr. King. The following winter was spent in Virginia City in a study of the Comstock lode, where the mines, then about 1,000 feet deep, had already produced 100 millions of dollars. In the following year the work had become more systematized, and, by parcelling it out in several parties each consisting of a geologist and topographer, by the close of an unusually long season it had been carried entirely across the Great Basin to the western shore of Great Salt Lake. In 1869 the remaining desert ranges of Utah, the great Wasatch Range and the western end of the Uinta Mountains were surveyed. This completed the work of the Survey as originally planned, and the party was then located at New Haven for the purposes of working up their large collections of rocks and fossils and platting their notes both geologic and topographic.

Mr. James D. Hague had detached himself from the field parties in 1868 to make a special study of the mining districts, and the result of his work, with some contributions from other members of the party, was published in 1870 as Vol. III. of the Survey reports, entitled 'Mining Industry.' The most important part of this volume is the elaborate study of the great Comstock lode, which has served as a model for all subsequent monographic studies of mining districts in this country, the only country in which such work has been done. In Chapter VII. of this volume, on the Green River coal basin, Mr. King defined the stratigraphical position of the coal-bearing rocks as undoubtedly Cretaceous, and gave a brief preliminary sketch of the general geological column as developed in the Wasatch Mountains, which he estimated as 56,000 feet in thickness below the Cretaceous.

Stratigraphical work in Nevada and Utah among the isolated mountain ranges, subsequently designated by Gilbert as the Basin Range system, was exceptionally difficult because these ranges were separated from each other by valleys 10 to 15 miles in width covered with an unknown depth of Quaternary detritus. Thus no stratigraphical sequence of rocks could be carried from one range to the other, and until the Wasatch Range was reached there was practically no starting point for the geological column, for most of the fossils collected were of new species, and their horizons could only be finally determined after a long comparative study.

Work at New Haven was abruptly interrupted in midsummer of 1870 by telegraphic orders from Gen. Humphreys to take the field at once, as Congress, without solicitation from any one, had passed the usual appropriation to continue the field work. As it was then too late to get together the necessary outfit for a campaign in the high mountain regions to the east of the Wasatch, the work of that season was devoted to a study of the extinct volcanoes of the Pacific Coast, which were apportioned, Mt. Shasta to Mr. King, Mt. Hood to Mr. Arnold Hague, and Mt. Rainier to myself. This work was interrupted by the winter snows, and, as Gen. Humphreys decided that the connection of these mountains with the 40th parallel was too remote to admit of its being taken up again, the only immediate fruit of the summer's geological campaign was a paper in the *American Journal of Science* (June, 1871), announcing the discovery of active glaciers on their slopes, the first then known within the boundaries of the United States.

In the summers of 1871 and 1872 the

work of the survey was carried eastward to the Great Plains, taking in the great Eocene beds of the Green River basin; the Uinta Range, unique on account of its east and west trend and its anticlinal structure; the Elkhead Mountains with their remarkable development of rare varieties of igneous rocks; the inclosed Mesozoic and Tertiary valleys of the North Park and the Laramie Plains; the Medicine Bow Range, with its series of Algonkian rocks, then classed as Huronian; and finally the northern extension of the Front or Colorado Range, with its granite core flanked by upturned Paleozoic rocks, which had thinned from 30,000 feet in the Wasatch section to less than 2,000 feet, and were only visible at a few points, being overlapped by Mesozoic or Tertiary beds, as the case might be.

The thorough study and discussion of the material gathered during these years of field exploration necessarily occupied much time, but the then-existing conditions protracted the work much more than would be the case at the present day. The topographical base of the five large atlas sheets was not completed until 1874. In the summer of that year a member of the Survey visited Europe and conferred with the directors of the leading Geological Surveys there on methods of treatment and of publication.

Microscopical petrography was then an unknown science in this country, and one result of this visit was that Prof. Ferd. Zirkel, of Leipzig, then the highest authority in this branch of geology, was induced to visit this country to examine the collections of igneous and crystalline rocks and take notes on their field habits. Chips for making thin sections were taken back by him on his return to Germany for systematic microscopical study, and his report (Vol. VI.) published in 1876 was the first work of this kind on American rocks.

The final determination of the fossils collected was confided to F. B. Meek, James Hall and R. P. Whitfield, at that time the only paleontologists competent to undertake so important a work, but they could only devote to this task moments of leisure from other and to them more pressing work, consequently it was nearly four years after the completion of field work before the geological material was finally ready for publication. The volume on Descriptive Geology by A. Hague and S. F. Emmons with the final sheets of the geological atlas went to press in 1876, and in the following year was written Mr. King's masterly summary of the whole work, designated 'Systematic Geology,' which discussed not only the general history and structure of the Cordilleran system, but also such subjects of general theoretical interest as the 'Genesis of granite and crystalline schists,' the 'fusion, genesis and classification of volcanic rocks,' etc.

The distinguishing character of this Survey, as compared with the other organizations, was that its work was founded on a complete and comprehensive plan adopted before taking the field, which in all its essential features was systematically followed out during the ten years of its existence.

Hayden Survey. The names of Hayden and Meek had long been identified with the geology of the Missouri Valley and the Great Plains, and when it was found in 1867 that of the appropriation for legislative expenses of the Territory of Nebraska there remained an unexpected balance of $5,000 it was very wisely given to Dr. Hayden to expend in geological researches in that territory. From this modest beginning grew, by a process of gradual evolution, what became finally known as the United States Geological and Geographical Survey of the Territories, the catalogue of whose reports constitutes a pamphlet of fifty pages. F. B. Meek and Dr. C. A. White assisted Dr. Hayden during the first

two years. In 1869 James Stevenson was appointed executive officer, a position which he continued to fill with credit until the end. In this year Persifor Frazer, jr., was attached to the party as mining geologist, and the line of geological travel, for such was the character of their work during the early years, led along the foothills of the Rocky Mountains from Cheyenne to Santa Fé. In 1870 it ran westward from Cheyenne through the South Pass to Fort Bridger, and back along the north slope of the Uinta Mountains.

In 1871, for the first time, two topographical assistants were attached to the party, and Dr. A. C. Peale made his first field season as mineralogist. The line of travel this year led from Ogden, Utah, via. Fort Hall, Idaho, to Fort Ellis (Bozeman), Montana. From there an excursion was made into the geyser region of the Upper Yellowstone, and the enthusiasm aroused by the view of these wonders of nature, and the representations of Dr. Hayden on his return, induced Congress to set the region apart as a National Park.

In 1872 the force was greatly augmented, the names of Holmes as artist and Gannett as astronomer first appeared upon the rolls of the Survey, and F. H. Bradley did a season's work as geologist and paleontologist. Work was conducted in two parties in the same general region that was visited in the previous year.

In the spring of 1873 James T. Gardner, who had been chief topographer of the 40th Parallel Exploration, was engaged as chief geographer, and the areal survey of Colorado was commenced. Work was carried on in three or more parties, each in charge of a geologist or of a topographer, as the case might be; but, as on the 40th Parallel Survey, geologist and topographer worked side by side, and the one had to suit his work to the exigencies of that of the other. This system had certain disadvantages, and on the 40th parallel it was sometimes found necessary to go back to study key points. Such a trip was made by Mr. King and the speaker to the Wasatch Mountains in 1873.

A. D. Wilson, who had also been topographer on the King Survey, joined the Hayden Survey in 1874. The areal survey of Colorado under the Hayden Survey was continued for four years, and finally completed in 1876.

Among the geologists, Marvine, who early showed great ability, had charge of the northern division for two seasons, but died before he had written up his second season's work. Dr. F. M. Endlich, who had studied in Germany, where he served on the Geological Survey of Baden, joined the Hayden Survey in 1874, and continued to the end in 1878. In Colorado he worked mostly in the southern part of the area mapped, as he was supposed to have a better knowledge of igneous rocks than the others, but in later years the practical test of his work by other geologists in the field has proved it to be less reliable than that of any of the other geologists.

Dr. A. C. Peale worked mostly in the central part of the State, and as he gained in experience proved himself a careful and intelligent worker. The genius of the party was W. H. Holmes, who, starting as an artist without previous geological training, gradually developed, as a result of his study of nature, a remarkable aptitude for structural geology. His drawings of mountains have never been equalled by any other artist in their combination of fidelity to nature, with artistic effect and keen insight into geological structure. The paleontologists, C. A. White, F. B. Meek, E. D. Cope and Leo Lesquereux, contributed in their special lines to the work in Colorado, the first also doing considerable field work. Other specialists were attached to the parties at different times, and the sons of many promi-

nent men in the East were temporarily attached to the various parties. W. H. Jackson, the eminent photographer, was also a member of the Survey.

Dr. Hayden's plan was to make the Survey as widely popular as possible, and one method of accomplishing this result was to publish a volume every year, abounding in excellent illustrations from the pen of Holmes, which were gratuitiously distributed in very large numbers. One consequence of this method was that the geologists did not have time to thoroughly digest their material, or correlate and compare it one with another. It is much to be regretted that in consequence no summary like the 'Systematic Geology' of King has ever been written of the Hayden work. The beautifully colored maps in the atlas of Colorado, which were compiled and drawn by Holmes, answer in one sense as such a summary, for they indicate graphically many general conclusions that are not to be found in the annual reports. The latter, on the other hand, often have a different system of geographical nomenclature from that given on the map, which renders them sometimes almost unintelligible.

The Colorado areal work joined that of the 40th parallel on the south. In the years 1877 and 1878 the areal work was transferred to Wyoming and carried northward from the northern limit of the 40th parellel maps northward to the Yellowstone Park. On this work St. John served one season in the Wind River country and in 1878 Holmes and Peale made an extensive study of the phenomena of the Yellowstone Park. Even photography has not accomplished, in all the time that has elapsed since, any improvement on the admirable illustrations drawn by Holmes of the geological wonders of this region.

Powell Survey. In the summer of 1869 Maj. J. W. Powell made, under the auspices of the Smithsonian, his famous boat exploration of the mysterious depths of the canyons of the Colorado River, starting from Green River City, on the Union Pacific Railroad, in May, and emerging from the mouth of the dark canyon nearly 900 miles below, three months later, a journey that is unequalled for its courage and daring in the annals of geographical exploration.

Already in the two preceding summers he had visited the valleys of many of the streams tributary to the Green River, and during 1870 and 1871 his explorations of the canyons were continued, still under the same auspices. With the narrative report of these explorations, published in 1875, appeared an admirable discussion of erosion and land sculpture in its relation to geological structure, defining for the first time *base-levels of erosion.* This, with the similar discussions of Gilbert, based on his studies of the Colorado Plateau region in 1871–2, have formed the starting point of modern physical geography.

In no part of the world can there be found so admirable a region to study the elementary processes of stratigraphical geology as in that traversed by Powell's exploration. It is, so to speak, nature's text book of geology, whose pages lie open to the inspection of any one who possesses the physical courage and endurance to reach the depths of its canyons. Hence, Powell's geographical exploration was at the same time a valuable contribution to geology, in that it opened the road to so important a field that had hitherto been supposed to be inaccessible except to the birds of the air.

The Powell organization soon became a geological exploration, receiving its appropriations directly from Congress, and assuming the title of Second Division of the United States Geological and Geographical Survey of the Territories. It did not attempt to make an areal survey of this interesting region, but devoted itself to monographic studies of some of the most novel

and striking features of its geology. In 1873 and '74 Powell himself, assisted by Dr. C. A. White, extended the geological observations made along the banks of the upper Green River into the surrounding country, and in 1876 published his report upon the geology of the eastern Uinta Mountains.

Under this organization also Mr. Gilbert made, in the summer of 1775, his classic study of the Henry Mountains, the most prominent among the laccolitic groups that project above the Colorado Plateau, and introduced for the first time the term *laccolite* into geological literature. This effectually refuted Scrope's dictum, which at one time was almost an axiom among Europe geologists, that igneous eruptions do not exert any elevatory force upon the surrounding sedimentary beds through which they have been extruded.

The final work of the Powell Survey was the study, in 1875-6 and 7, of the High plateaus of Utah by Captain C. E. Dutton, an officer of the Ordinance Corps of the United States, on detached duty; he also made the petrographical examination of the igneous rocks brought in by Gilbert from the Henry Mountains. To this report, which was published in 1880, there was appended a prefatory note by Major Powell, giving a general sketch of the orographic movements recorded by him during his investigations in the Plateau region.

Wheeler Survey. I have reserved my mention of the work of the Wheeler Survey to the last, although chronologically its geological work antedates much that has already been mentioned, for the reason that as an organization, as indicated by its title (United States Geographical Surveys West of the 100th Meridian), it did not recognize geology as an essential part of its work.

The Wheeler Survey was indirectly an outcome of the 40th Parellel. When two seasons' campaigning of the latter organization had proved the practical feasibility of conducting such work in the Western mountains, Lieutenant G. M. Wheeler, of the United States Engineers, secured the consent of his chief to undertake, in the summer of 1869, a military reconnaissance for topographical purposes in southwest Nevada and western Utah. Although no geologist was attached to this first expedition, visits were made to various mining districts, but the reports thereon, like the ordinary mining reports of the time, were of little or no geological value. From this gradually grew up an important organization supported by direct appropriations from Congress, which contemplated the making of a topographical map of the whole area of the United States west of the 100th meridian, and which in point of numbers finally far exceeded any of the other organizations.

Its work was carried on continuously from 1871 to 1879, and produced a large number of topographical maps of the western country, a few of which were afterwards colored geologically.

Wheeler did not approve of the system of topographical survey adopted by the 40th Parallel and subsequent surveys, but conducted his work after the manner of earlier military expeditions, by making meander lines along the valleys, instead of triangulations from the summits of the ridges, the principal basis of his details of topographical structure. His maps, morever, were drawn in hachures instead of in contour lines.

In spite of the somewhat discouraging peculiarities of organization, the geological work done under this survey reached a high standard of excellence, owing to the ability of the men to whom it was entrusted. First among these was Gilbert, who as chief geologist, worked in the Great Basin of Nevada, in eastern California and southwestern Utah in the summers of 1871 and '72, visiting the plateau region around the mouth of

the Canyon of the Colorado in the former year; he had A. R. Marvine as his assistant in 1871, and E. E. Howell in 1872. In 1873–'74 he extended his investigations further south into New Mexico and Arizona, and in the following year left to join the Powell Survey.

Gilbert in his reports on the work of these years (published 1875) did not pursue the descriptive method in presenting the results of his geological observations, but discussed them at once as a whole under general heads.

In this way he first characterized what he designated the 'Basin Range' system of mountain uplift, as brought about mainly by faulting, in contrast to the structure of the Appalachian Mountains, which is produced mainly by plication. The geologists of the 40th Parallel regarded the uplift of the narrow ranges of Nevada, from which the term was derived, to be produced primarily by folding, and that the faulting was a later phase in Tertiary or post-Tertiary time, in contradistinction to the more modern interpretation of Basin Range structure as a system of tilted beds without plication.

His volume also contains able discussions on land sculpture and erosion, on the Glacial period, and the conditions attending the drying up of the ancient lake which once filled the Utah basin, and to which he gave the name of Lake Bonneville, from the explorer who first determined that the basin has no exterior drainage. He also had a chapter on recent volcanic manifestations and a section of the rocks shown in the Canyon of the Colorado.

In 1873 Prof. J. J. Stevenson was also employed on the Survey and made a rapid reconnaissance through the greater part of Colorado. Hurried as this work necessarily was, his report shows the grasp of mind of the trained geologist, but his results were soon superseded by the more detailed areal work of the Hayden Survey.

In 1874 E. D. Cope did some field work as vertebrate paleontologist, and in 1875 Jules Marcou was attached to one of the Californian parties and determined the Tertiary age of the Tejon beds. In 1876 A. R. Conkling was attached to the Survey as geological observer, and 1877 J. A. Church made a second study of the Comstock lode, the results of which appeared in a private publication.

J. J. Stevenson was again attached to the Survey in 1878 and 1879, with I. C. Russell as assistant, during which time he had an independent party under his own charge, and he was making valuable contributions to the geology of southeastern Colorado and northern New Mexico, when by legislative enactments the Survey came to an end.

From a geological point of view the system pursued on the Wheeler Survey was less advantageous and, in proportion to the expense, less productive of permanent additions to geological knowledge of the country involved than either of the other organizations. The parties as a rule were under the charge of a military officer, who might have ideas of military discipline not always consonant with the best interests of geological work.

Black Hills Surveys. Among military reconnaissances the more important from the geological point of view were those undertaken as a result of the mining excitement in the Black Hills, of the attacks upon miners by the Sioux Indians, within whose reservation they lay, and their consequent appeals for government aid and for the opening of the reservation for white settlement.

The reconnaissance across the southern end of the hills, returning around their northern flanks, which was under the command of Capt. Wm. Ludlow, in the summer of 1874, was accompanied by N. H. Winchell and Geo. B. Grinnell as geolo-

gists. It was their first experience among Western geological formations, and considering the rapidity of the march it is not surprising that no considerable additions were made to the geological knowledge of the region.

In the summer of 1875 and 1876, however, Wm. P. Jenney and Henry Newton were sent out under military escort to investigate the mineral resources and geology of the Hills, in order to determine whether the reports of the great mineral wealth were well founded. The untimely death of Mr. Newton, who was a most promising young geologist, delayed the publication of the scientific results of this investigation, which was finally accomplished in 1880, under the editorial supervision of Mr. G. K. Gilbert, who kindly undertook the very delicate task of putting in form the field notes of Mr. Newton.

Among other reconnaissances to which geologists were attached may be mentioned those in 1873, of Capt. W. A. Jones, in northwestern Wyoming, with T. B. Comstock as geologist, and that of Lieut. E. H. Ruffner, into the Ute county around the San Juan Mountains, on which Prof. H. Hawn and L. Hawn served in geological capacities.

In the year 1875 E. S. Dana and G. B. Grinnell accompanied the party of Capt. Wm. Ludlow on a reconnaissance from Carroll, Montana, to the Yellowstone Park. On this trip they got glimpses of the isolated groups of mountains rising out of the plains, such as Little Rockies, Crazy Mountain, etc., that have yielded such interesting petrographical data of later years. They collected Saurian remains in beds overlying the Fox Hills Cretaceous at the mouth of the Judith River and made many interesting observations on probable unconformities in the Bridger Mountains and elsewhere.

The eagerness with which geologists have pursued their investigations into the new fields of geological observation, opened up by these various explorations, may be compared in a certain sense with that which takes possession of prospectors and miners upon the discovery of some new and extraordinarily rich mining district.

In their emulations to obtain possession of some of the stores of scientific wealth which nature has exposed to view, and to gain the reward of scientific reputation which is accorded to the first discoverer, they are sometimes inclined to neglect the rights of priority which scientific courtesy accords to the first occupant of a new field.

Thus the publication of Powell's geological report was, in so far as it related to the Uinta Mountains, in contravention of a more or less definite agreement among the heads of the various surveys not to encroach upon the areas covered by the maps of the 40th Parallel Survey, since the work of this Survey was strictly confined within previously prescribed limits, while the whole West lay open to the others. Powell's report was published in 1876, and the topographic base of the 40th Parallel map of the Uinta Mountain region had been used, by permission but without acknowledgment, in the preparation of the map which accompanied that report. Furthermore, during the summer of 1875 the geologically colored map of the same region, prepared by the geologists of the 40th Parallel, was in press in the cartographic publishing house of Julius Bien, and upon its final completion on November 12, 1875, Mr. King sent out to the leading geologists of the country 12 copies of these maps signed and dated by the authors, in the hope of securing to them the priority of record which was their due.

Already in 1873 friction had sprung up between the Hayden and Wheeler Surveys. Neither was willing to accord to the other the exclusive right to survey any particular part of the geologically unexplored regions,

and each claimed the privilege of stretching its work over the whole unsurveyed area of the West. Thus in this year each party had geological and topographical parties covering the same ground in Colorado, which was a deplorable dissipation of energy when so much ground was untouched by either party. As time went on, this friction increased to such an extent that the influence of one party with Congress was used to curtail the appropriations allotted to the other.

At first glance it would seem that such disagreement among men, whose sole object was avowedly the advancement of science, was most unfortunate, but here again the truth of the old saying about an 'ill wind' was again proved, for Congress, unable to decide of itself on the merits of the contending parties, referred the matter to a committee of the National Academy of Sciences, and, acting on their report, passed a bill terminating all the previously exististing explorations and creating the United States Geological Survey. Thus, instead of a number of rival organizations with no necessity of concordant action between them, and each liable to pass out of existance at any time by the failure of Congress to pass its annual appropriation, there has resulted the present organization, which forms a constituent part of the Department of the Interior, and has thereby acquired a permanence which invites the best scientific talent of the country to take part in its work.

S. F. EMMONS.
U. S. GEOLOGICAL SURVEY.

PROFESSOR EUGEN BAUMANN.

ON the 2d of November, 1896, occurred the death of Dr. Eugen Baumann, professor of chemistry in the medical faculty of the University of Freiburg, in Baden. The deceased was born in Würtemberg, in 1846, and obtained his early education at Stuttgart. After studying chemistry, physics and natural sciences, at the Stuttgart Polytechnicum, where he worked under Fehling, he served an apprenticeship as apothecary in his father's employment, and in 1870 passed the pharmacists' examination at Tübingen. This was the occasion of his first meeting with Hoppe-Seyler, to whose encouragement and inspiration his career as an investigator owed its beginning. A life-long friendship was formed between the two men, and only a few months before his death Baumann paid fitting tribute to his great teacher in an obituary published with Kossel.*

Already an assistant to Hoppe-Seyler, Baumann obtained his doctor's degree at Tübingen, in 1872, with a dissertation on vinyl compounds.† When Hoppe-Seyler was called to take charge of the instruction in physiological chemistry in the newly opened German university at Strassburg, Baumann accompanied him thither as his first assistant, and in 1876 became 'Privatdocent' in chemistry. At the opening of DuBois Reymond's new physiological institute at Berlin, in 1877, Baumann was appointed to have charge of the chemical laboratory; upon his departure from Strassburg the medical faculty honored him by conferring the degree of doctor medic. *honoris causa*. In 1882 Baumann was appointed professor extraordinarius in the Berlin medical faculty, and in October, 1883, he accepted a call as successor to v. Babo at Freiburg, where he labored without interruption until his death. He declined the call to succeed Hoppe-Seyler at Strassburg and only recently the title of 'Hofrat' was bestowed upon him.

Baumann's earliest researches were intended to throw light upon the behavior of sarcosin in the organism. To this period belong the beginnings of the researches on the aromatic substances of the body—a

* Zeitschrift für Physiologische Chemie, Band 21.
† Ann. Chem. Pharm. Band 163. S. 308.

'field of work which occupied Baumann's attention during his entire life. The observation that phenol bodies constantly present in the urine are not derived from the aromatic substances in the vegetable foods was followed by the important discovery that these bodies are excreted combined with sulphuric acid in the form of ethereal sulphates. With the isolation of these compounds (*e. g.*, phenyl- and cresylsulphates) there was introduced into physiology the knowledge of a new class of syntheses in the organism, comparable to the well known synthesis of hippuric acid. The finding of phenol as a putrefaction product of proteids led to the announcement that the aromatic substances of the urine largely owe their origin to the putrefactive decomposition taking place in the alimentary tract. The products, many of them strongly toxic, are absorbed and reappear in relatively harmless combination with sulphuric acid. Ethereal sulphates were shown to be absent in the urine when intestinal putrefaction is totally suppressed, and physiologists have come to look upon the quantity of combined sulphuric acid excreted as the best indication of the intensity of the decomposition in the intestine. The so-called 'indican' of the urine was also drawn within the scope of these investigations and was shown to be quite distinct from the vegetable glucoside indican, although yielding indigo on oxidation. After Jaffé had demonstrated that the chromogen of the urine is derived from indol, Baumann and Brieger proved that it is in reality an ethereal compound of indoxyl with sulphuric acid, analogous to those already mentioned. It is scarcely necessary to remark that these discoveries have had a far-reaching influence on practical medicine.

The behavior of sulphur compounds in the animal organism was another favorite theme to which Baumann and his pupils contributed extensively. The study of the compounds of mercapturic acid which can be obtained under appropriate conditions in the urine, yielded the proof that there is formed in intermediary proteid metabolism an atom-complex closely related to the organic sulphur compound cystin, excreted as such in the rare cases of so-called cystinuria. It was shown that the cystin is accompanied under these circumstances by at least two diamines (putrescine and cadaverine) which are found in both urine and fæces. The peculiar perversion of metabolism known as alcaptonuria was also shown to owe its peculiarities in many instances to a dioxyphenylacetic acid, the synthesis of which was accomplished in the Freiburg laboratory.

Among Baumann's pharmacological investigations may be mentioned in particular his researches on the sulfones, which led to the discovery of several widely used hypnotics: sulfonal, trional, etc. Together with Kast and others he studied their physiological action and demonstrated that only those are effective which are transformed in the body, the intensity of their action being dependent upon the number of ethyl groups present.

Scarcely more than a year ago the finding of iodine as a normal constituent of the animal body and the isolation of thyroiodin (iodothyrin), the physiologically active substance of the thyroid glands, aroused the interest and admiration of the medical world. Baumann was actively engaged in the solution of many problems suggested by this last great discovery when, after an illness of only two days, death put an end to a brief but brilliant career.

It is impossible in a brief sketch to give more than an outline of some of Baumann's contributions to physiological chemistry. His loss will be felt not alone by chemists, but also in the broader circle of investigators in scientific medicine; for Baumann exercised a wide influence as a teacher, as

well as through his permanent researches. Among those who benefited by his guidance may be mentioned the names of Brieger, Goldmann, Herter, Hürthle, Kast, C. Th. Mörner, Preusse, Röhmann, Schotten v. Udránszky, N. Wedenski. One who came into personal contact with the man could not fail to admire his untiring devotion to science, and to feel grateful for the inspiration derived from him.

LAFAYETTE B. MENDEL.
YALE UNIVERSITY.

ALFRED TRESCA.

THE session of November 27, 1896, of the '*Société d'Encouragement pour l'Industrie nationale*,' under the presidency of M. Mascart, was devoted mainly to ceremonies in memory of the late M. Alfred Tresca, recently deceased. The discourse pronounced by M. Haton de la Goupillière was the main feature of the evening programme.

Monsieur A. Tresca was the son of the distinguished investigator, Henri Tresca, who was the successor of General Morin as the head of the *Conservatoire des Arts et Métiers*, and who followed and improved upon the methods of the latter in the prosecution of researches of importance in the field of applied science, and especially in the investigation of the characteristics of the materials of construction and of the most important classes of prime movers and other machines. The younger Tresca followed in the same path and gave his life to similarly valuable work. The three men have lead rather than followed in all developments in their department of work during the century. The work of Morin on the properties of the materials of engineering and his extensive introduction, in original ways, of graphical methods of illustration, the extensive study by the elder Tresca of the heat-motors, and the researches of the younger Tresca in applied physics and engineering, have been the principal contributions of the *Conservatoire*, for many years past, to their department of science. It is an interesting case of 'intellectual heredity,' as the writer has called it. A personal acquaintance, slight, but quite sufficient to confirm the conclusions here reached, impressed the writer also with the fact that the influence of each upon his successor, in this respect, was deep and most effective of result. The three men, talented, industrious and persistent, by similar methods accomplished similarly useful work.

As M. Haton says: "Inheritor of a name illustrious in science and honored also for services rendered our society, he has firmly upheld its prestige. Trained in the school of his father, Henri Tresca, he learned the traditions of industrial science, that difficult science, and, at the same time, traditions of honor and of labor to which he was always faithful." He was always inclined to avoid public notice, "but his colleagues, his students, unanimously render just tribute both to the extent of his work and to its value in instruction." The address closes with an affectionate and graceful tribute of esteem and admiration, of grief and of eulogy.

R. H. T.

CURRENT NOTES ON ANTHROPOLOGY.

ANCIENT MAYAN HISTORY.

A YUCATECAN author, Don Juan Francisco Molina Solis, has recently written a meritorious history of Yucatan (Historia del Descubrimento y Conquista de Yucatán, pp. 911. Merida, 1896). By way of introduction it has a sketch of the ancient history of the peninsula, covering sixty pages

This discusses the early immigrations, the foundation of the great cities, the establishment of the confederation which for some generations appears to have controlled the peninsula and allowed a peaceful development of its culture, and its unfortunate violent dissolution leading to the destruction of the former mart of Chichen Itzá

and the capital, Mayapan. This breakdown took place in the first half of the fifteenth century, probably about 1420.

The author presents the surviving fragments of this story in clear and attractive language, basing his statements on the the best authorities and some unpublished documents. His work as a whole is of high character, and will take a worthy rank in the historical literature of Spanish America.

PRIMITIVE DRILLS AND DRILLING.

To bore a hole seems a simple affair, but it took man a long time to learn how to do it. Mr. J. D. McGuire, in the *Report* of the United States National Museum for 1894 (just issued), devotes a hundred and twenty-five pages to the subject. He claims, indeed, in his opening sentence that "The earliest remains of man are found associated with implements of his manufacture in which holes have been artificially perforated." This is incorrect, as the remains of the Chellean period are not perforated, and he himself offers no evidence to that effect. Nor does he give the right explanation for the 'batons of command' of the cave period. They are arrow-straighteners and are still used by the Eskimo.

These are small matters. The article in all its leading features is clear, profound and convincing. He surveys all the forms of drills and hole-making implements of primitive times—pins, bodkins, needles, awls, etc.—and illustrates how they were used and for what purpose. Fire-drills are abundantly represented, and the theory that the Egyptian *Sam* is a drill is ably defended. Numerous cuts render the text easily comprehended, where mechanical devices are discussed.

THE STATE AND ITS SOIL.

Prof. Frederick Ratzel is one of the best known students of the relations of earth to man. His prize essay, 'Der Staat und sein Boden, geographisch betrachtet' (Leipzig, 1896, pp. 127), is a careful discussion of the influence which the soil and its accessories bear upon the character and development of the inhabitants. It considers the state as a 'territorial organism,' explains the connection between the natural and political areas, traces the development of this connection, and maintains the nigh inseparable association of the two.

Prof. Ratzel is always a clear, agreeable writer. His learning is adequate to his subject. To many readers, however, this and his other works will seem to be a little arid and incomplete, from the absence of warmth of touch, of psychical sympathy, or, perhaps, want of consideration for the predominance of the will and the emotions in the affairs and the evolution of mankind.

D. G. Brinton.
University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

THE DAVY-FARADAY RESEARCH LABORATORY.

The Davy-Faraday Research Laboratory, which we have already described, was opened by the Prince of Wales on December 21st. The laboratory, which Dr. Ludwig Mond has presented to the Royal Institution, has cost for its building, equipment and endowment about $500,000. The laboratory is to be devoted to research work in physics and chemistry, and Lord Rayleigh and Prof. Dewar have consented to undertake the directorship. Dr. Mond made an address in the course of which, according to the report in the London *Times*, he said that psrsons of either sex or any nationality would be welcome within its walls who could satisfy the laboratory commmittee that they were fully qualified to undertake original scientific research in pure and physical chemistry, and preference would naturally be given to those who had already published original work. If this country had distinguished itself in one way more than another in that glorious rivalry with other nations for extending our knowledge of natural phenomena and our power over the forces of nature it had been by the large num-

ber of contributors to our knowledge, who on the Continent would be called amateurs in science—men who devoted their lives to the study and advancement of science from pure love for the subject. He need only instance the names of Cavendish, Joule and Darwin to show that they included men of the very highest rank. In giving this laboratory to the English nation he had done so in the firm conviction that this country would continue to bring forth in the future, as it had done in the past, men of the same rank and of the same devotion to science for its own sake, and it was a fond hope of his that such men would find there all the facilities and all the necessary appliances for carrying out their researches. The further we advanced in the study of nature the more accurate and elaborate was the apparatus required, and the more difficult it became to carry on delicate work in a private laboratory. He had placed that laboratory in the center of London because he believed that this great city would continue to be the intellectual center of the civilized world, where the brightest minds would congregate. He had intrusted it to the Royal Institution so as to insure its being open to men and women of all schools and of all views on scientific questions.

THE MARINE BIOLOGY OF GREAT BRITAIN.

THE committee of the British Association on the marine zoology, botany and geology of the Irish Sea presented, at the Liverpool meeting, its fourth and final report. The committee consisted of ten members, with Prof. W. A. Herdman as chairman and reporter. The report reviews the earlier work by the Liverpool Marine Biology Committee and the investigations carried out in the Puffin Island station since 1887. That committee, in addition to annual reports, has published three volumes of the fauna, recording 2,133 species. In 1892 the committee relinquished Puffin Island and built the new biological station at a very much more convenient and richer locality, Port Erin, at the southwest end of the Isle of Man. In the following year a second building—the Aquarium—was added, and since then the institution has been constantly in use and has proved increasingly useful each season, both to members of the committee and to other naturalists. Since the opening of the Port Erin station, in 1892, 56 biologists have paid over 200 longer or shorter visits for the purpose of working at the marine fauna and flora. The British Association Committee for the investigation of the Marine Zoology, Botany and Geology of the Irish Sea was appointed in 1892, and three previous reports have been submitted. The first, laid before the Nottingham meeting in 1893, gave an account of the limits and more prominent physical conditions of the area under investigation, with a brief interim notice of the dredging expeditions undertaken during the year. The second report, at the Oxford meeting in 1894, gave a fuller description of the methods of work on one of the dredging expeditions, and also included an account of the distribution of the submarine deposits of the area and a notice of the chief results of the year's work, including some new species. The third report, given at Ipswich, dealt chiefly with the submarine deposits, the investigation of the surface currents, and with the distribution of animals as shown from dredging statistics. In the present final report the committee gives for the first time a complete list of all the species recorded from the area of the Irish Sea investigated. This list fills 28 pages. The greater part of the work of the committee has been zoological; botany, however, has been represented by several investigators, and lists are given of the marine algæ, including diatoms.

DURING the last fifty years, says *Nature*, much work has been done by marine naturalists all round the British coasts, with a view to determining the distribution of those animals which live on the floor of the sea. It has been fully recognized that the localities frequented by many marine species are very definite and extremely limited in extent, and that both the nature of the sea bottom and the creatures which live there exhibit as much variety as we are accustomed to find on land. The Marine Biological Association, with the assistance of a grant made for the purpose by the Royal Society, has recently been engaged in an attempt to place our knowledge of this subject upon a sounder basis by investigating in detail some of

the grounds in the neighborhood of Plymouth, including important fishing grounds, with reference to the nature of the sea bottom at each locality, and the whole assemblage of animals found there. Detailed charts are being prepared to exhibit the variations which take place from point to point. No attempt has previously been made to study fishing grounds with such thoroughness, having regard not only to the fishes, but to the whole collection of animal life which forms the basis of the food upon which the fishes exist. The investigation, which has involved a large amount of dredging and trawling, as well as the identification of the numerous species captured, has been carried out by Mr. E. J. Allen, the Director of the Plymouth Laboratory.

GENERAL.

THE remains of Pasteur were removed, on December 26th, from the Cathedral of Notre Dame to the Pasteur Institute, where the cortège was met by members of the Academy, representatives of the government and delegates from learned societies and foreign countries. Speeches were made by M. Rambaud, M. Bodin; Sir John Evans, representing the British Association; Sir Dyce Duckworth, representing the Royal College of Physicians, and others. A mausoleum, to be decorated with designs illustrating Pasteur's contributions to science and industry, has been built at the Institute.

DR. THEODORE G. WORMLEY, since 1877 professor of chemistry and toxicology in the University of Pennsylvania and the author of important contributions to these sciences, died at Philadelphia on January 3d, aged seventy years.

THE death is announced, in his eightieth year, of Mr. Horatio Hale, of Clinton, Ontario, well known for his contributions to our knowledge of the languages and customs of the North American Indians.

DR. F. BUKA, professor of geometry in the University of Berlin, died on December 4th, at the age of forty-five years.

MR. EDWARD FALKENER, the English archæologist, died on December 17th, in his eighty-third year.

SIR HENRY MANCE has been elected President of the Institution of Electrical Engineers, London.

M. LIARD, the head of the University Department of the French Ministry of Education, has been elected a member of the Academy of Moral Sciences in the place of the late M. Jules Simon.

THE tercentenary of the birth of Descartes has been celebrated at Tours by the local archæological society, two addresses being delivered and verses composed by M. Sully Prudhomme being recited. A pilgrimage has also been made to the house at La Haye in which Descartes was born.

THE jubilee of the entrance into professional life of Dr. Roussel, of Paris, has been celebrated at the Sorbonne. Mr. Barthou, Minister of the Interior, presented him with a gold medal, and his bust was unveiled. In 1874 Dr. Roussel, who has been a Deputy and is now a Senator, carried a bill for the protection of infants placed out at nurse. This measure checked the abuses of baby farming. Dr. Roussel has also effected legislation against drunkenness, for the protection of foundlings, and for gratuitous medical aid for the poor.

MR. FREDERICK IVES gave a lecture, on December 16th, at the Fine Arts Societies Galleries in London, on his method of photography in natural colors, and exhibited photographs so taken.

AT the annual business meeting of the Geological Society of Washington, held December 23, 1896, officers for the ensuing year were elected as follows: President, Arnold Hague; Vice-Presidents, J. S. Diller and Whitman Cross (re-elected); Treasurer, M. R. Campbell; Secretaries, C. Willard Hayes and T. W. Stanton (re-elected); Members-at-Large of Council, S. F. Emmons, G. K. Gilbert, R. T. Hill, G. P. Merrill and Chas. D. Walcott. Mr. Walcott subsequently tendered his resignation from the Council, leaving a vacancy.

THE American Economic Association held a successful meeting at Baltimore, ending December 31st. The following officers were elected: President, Henry C. Adams, Ph. D., Michigan; Vice-Presidents, Franklin H. Giddings, M. A., Columbia, E. R. L. Gould, Ph D.,

Johns Hopkins, Roland P. Falkner, Ph. D., Pennsylvania; Secretary, Walter F. Wilcox, Ph. D., Cornell; Treasurer, Charles H. Hull, Ph. D., Cornell.

THE Swedish Consul-General at Shanghai has telegraphed to Stockholm that Dr. Sven Hedin, the Scandinavian traveller, has arrived at Liang-chau-fu, in Kansu, to the northeast of Lake Koko Nor, after a successful journey through the unknown regions of northern Tibet by way of Tsaidam and Koto Nor. Dr. Sven Hedin hopes to reach Peking in two months' time.

DR. ANDRÉE proposes to repeat his attempt to reach the North Pole by balloon this year. Dr. Knut Frankel expects to accompany him as meteorologist in place of Dr. Ekholm. It is also reported that MM. Godard and Surcouf, two French aëronauts, propose making a similar attempt in 1898.

THE *Lancet* states that some interesting 'Druidical' remains on and around Dartmoor have been destroyed by the contractors of the Newton Royal District Council, who have broken up the stones for repairing the surface of the roads. The remains known as the Stone-avenue, at Bel Tor corner on Sherberton-common, have been demolished, and several 'hut circles' and 'mainhir' have completely disappeared. Fortunately the work of destruction has been now stopped by the energetic action of Exeter antiquaries, but the loss of these interesting relics is much to be deplored.

ACCORDING to the report of the Board of Health of New York City the death rate for 1896 was 21.54 as compared with 23.105 in 1895, and an average of 26.63 for the five preceding years. The total number of deaths during 1896 was 41,652, and of births 55,723. The estimated population of New York City on July 1st was 1,934,077.

THE Common Council of Brooklyn voted November 30th to establish a public library for that city, in the interest of which a public meeting will be held at the Brooklyn Academy of Music, January 14, 1897, in connection with the joint meeting of the New York Library Association and New York Library Club which occurs the same day at the Art Institute.

THE New York *Evening Post* reports that in the Berlin Museum of Ethnology the large and valuable collections of Gustav Nachtigal have now been placed. These collections date from 1884–85 and comprise all sorts of objects from the west coast of Africa, beginning on the Orange River south and ending on the Volta north. All the objects are flawless, and among them are full native equipment in weapons, tools, apparel, religious rites, household utensils, etc., the finest pieces coming from Borneo, Wadai, Darfoor, Kordofan, and from the districts along the Niger and in the Sudan. Some of the native garbs are exquisitely woven and ornamented, silk and gold.

THE William Gossage Laboratory and the extension of the chemical laboratories of University College, Liverpool were opened on December 12th, by the Earl of Derby. The former includes a large laboratory with accommodations for 44 advanced students, and in the basement is an additional lecture room to seat 70 or 80, a preparation room and a gas-analysis room. The other new buildings comprise a metallurgical laboratory, with furnaces and other equipments, an important addition to the research laboratory, store-room for apparatus and chemicals, a dynamo room, electric-accumulator room, and a heating chamber. The William Gossage Laboratory was built by Mr. F. H. Gossage and Mr. T. Sutton Timmons, at a cost of £7,000, and presented to University College. To connect the laboratory with the old building, other buildings are being provided by public subscription, and the cost will be about £4,000. The opening address was delivered by Prof. W. Ramsay.

IT is reported that patents for inventions which relate to the production of electrical energy, or in which electricity is in any way employed, are refused in Turkey. There is nothing in the law to warrant any such refusal, and the only explanation afforded by the Turkish authorities is that orders have been received 'from the Palace' forbidding the grant of patents for such inventions. The fees paid on application are not returned.

MR. FRANCIS GALTON recently contributed to the *Fortnightly Review* an article describing

how a system similar to that of the Morse code might be used in signalling to the planets. We now find in a leading daily paper an article with the headline 'Mars is Signalling Us,' including an account of the method by which the signals are recorded in 'one of the great European observatories.'

It is probable that but few people realize the number of 'scientific' journals published in America. One of these which has now concluded its tenth volume is devoted to 'Koreshanity,' founded on "Koreshan astronomy, the basis of which makes the sun the center and the earth the circumference of the universe, from which it is conclusive that the earth is a hollow sphere, with its habitable surface concave, forming an integral, alchemico-organic structure, which, as demonstrated in the cellular cosmogonic system, perpetuates itself through the eternal and causative forces and functions operating within it."

A petition has been received asking subscriptions in aid of those who suffered from the effects of a waterspout on the island of St. Michael, in the Azores. It is stated in the petition that on November 25th a great waterspout broke over the city of Povoacao, of about twenty-five thousand inhabitants. Almost in an instant the deluge mounted above the roofs of the houses, after tearing up the pavement of the streets in its course, and digging trenches in them, in some places fifteen feet below their ordinary level. It was in the night that the waterspout broke, and the great torrent, rushing down the slopes to the sea, tore a wide channel through nine miles of country, bearing away the homes of thousands of people and causing great destruction of life.

A serious landslide has occurred near Rathmore, County Kerry, Ireland. Part of the earth composing a bog, carrying with it rocks, trees, houses and animals, has been swept into the river Flesk and the lakes of Kilarny.

Giant's Causeway, in the north of Ireland, from the early part of the last century down to the present day, has been visited by a largely increasing number of persons without let or hindrance, and it is now annually visited by about 80,000 persons. A small limited liability company was formed in June last for the purpose of enclosing the causeway and making a profit out of it by charging a toll for admission. A few months ago they began to put up an iron fence, and they have brought an action against three gentlemen who persisted in walking over the causeway. To defend the public right of access to it, the National Footpath Preservation Society has issued an appeal for funds to defend the case.

According to cablegrams to the London *Times*, vigorous measures are being taken in South Africa to stop the spread of the rinderpest. The Premier of Cape Colony has stated that the disease had not advanced towards the colony in the past two months. The government were utilizing the peculiar geographical advantages of the country, which would enable the border to be fenced from the Atlantic on one side to the Indian Ocean on the other, and they entertained distinct hopes of saving the colony and Pondoland from the ravages of the epidemic. The government, Sir Gordon Sprigg added, were doing everything that was humanly possible to that end, and the farmers and natives, to whom he had fully explained the situation, were anxiously assisting the efforts of the government by every means in their power. Major Leutwein, Governor of German Southwest Africa, took measures at the beginning of October to prevent the introduction of rinderpest into the colony. The southern border has been entirely closed by means of patrols between the existing stations, and in the Simon Kopper territory, near the Kalahari desert, an additional station has been erected. The eastern frontier is guarded by stations and patrols which, though sufficient to prevent men or cattle from crossing the border, are unable to hinder the movements of game or wild animals. To the north and northeast similar measures are being taken to prevent the introduction of the disease from the neighborhood of Lake Ngami. It is to be hoped that the praiseworthy efforts of the German authorities to prevent the spread of the rinderpest may be crowded with success.

The New York Academy of Medicine will celebrate the semi-centennial of its foundation on January 29th. There will be exercises in

Carnegie Hall at which addresses will be made by President Cleveland, Prof. Jacobi and others, and afterwards there will be a reception at the building of the Academy, the corner stone of which was laid by President Cleveland in 1889.

BRANCHES of the British Medical Association are being formed in the leading cities of Canada as a preliminary of the visit of the Association next year. Montreal, Ottawa, Halifax and Winnipeg have already strong local branches.

UNIVERSITY AND EDUCATIONAL NEWS.

THE cablegram report that Alfred Nobel had left his fortune to Stockholm University is now said to be incorrect. A cablegram from Stockholm, dated December 31st, states that the fortune, valued at $10,000,000, is almost entirely bequeathed for the foundation of an international fund for the advancement of scientific research.

THE Stevens Institute of Technology, Hoboken, N. J., will celebrate its twenty-fifth anniversary on February 18th and 19th.

PRESIDENT HARPER, of the University of Chicago, has announced a deficit for the year of $48,000, and that retrenchment will be necessary especially in the direction of scholarships and assistance to students.

GEN. G. W. C. LEE has resigned from the presidency of Washington and Lee University, to take effect at the end of the academic year.

AT the inauguration of the Lyons University, the rector, M. Compayré, announced a donation to the University of £4,000. The *British Medical Journal* states that the donor is M. Auguste Falcouz, a Lyons banker. The interest of this sum is to be disposed of as follows: Every two years a prize of £40 sterling will be given to the students of each of the four faculties—literature, science, law and medicine—who write the best essay on a current subject. All French students under 30 years of age can compete. The subject of the essay will be chosen by the Council of the Lyons University a year in advance. Every two years instruments for the science and medical faculties will also be bought. When fifty years have elapsed, the Lyons University will have entire control over the capital in order to be able to meet the demands of scientific progress.

THE Austrian government has brought in a bill on the salaries of university professors. The present salary of a professor is now about $1,200, and he receives in addition the fees from students attending his courses. It is now proposed to raise somewhat the fixed salaries and let the fees of students go to the state. This would equalize the salaries of professors, but is being opposed especially by professors in the medical school whose required courses are attended by a large number of students.

WE recently referred to the action of the regents of the University of the State of New York making it illegal for colleges of the State to give the degrees A. B. and Ph. D. *causa honoris*. When colleges in other states either voluntarily or by compulsion cease giving the Ph. D. degree *causa honoris* and for study *in absentia*, those who wish to possess this 'honor' without the education it represents will need to go to the newly founded 'university' at Buenos Ayres. It appears that they can there receive the degree by a course of study in extent (information regarding its thoroughness is lacking) about equal to that in an American college as far as the end of the sophomore year. The candidates for the doctorate, it appears, need not know any mathematics, but they must study one science—geography, and that of both the 'old and new continents.'

A SECOND university will be opened in Japan during the present year. It will be at Kyoto and will for the present only include professional schools. It is also reported that a Dutch university will be established in Pretoria. An English university at Cape Town seems to be much needed.

PROF. B. HATSHECK, of Prague, has been called to the chair of zoology in the University of Vienna, vacant by the resignation of Prof. K. Claus. Prof. Th. Curtius, of Kiel, has been called to the chair of chemistry at Bonn, vacant through the death of Kekulé. Dr. P. E. Study, associate professor of mathematics at Bonn, has been called to the chair of mathematics at Greifswald. Dr. Schüsler, of the

Polytechnic Institute of Graz, has been promoted to an assistant professorship of Geometry and Dr. W. Felix, of the University of Zurich, to an assistant professorship of anatomy.

DISCUSSION AND CORRESPONDENCE.

CLOUDS OVER A FIRE.

On Tuesday, December 1st, I had an excellent opportunity to observe the formation of cumulus clouds over the smoke from a large fire. The morning was clear, with the exception of a few scattered strato-cumulus and cumulus clouds near the horizon. The wind was northwest and blowing at about 12–15 miles an hour. The fire was in the coal pockets of the Boston and Maine Railroad, in Charlestown, and burned fiercely for some hours, sending up immense volumes of smoke which were blown off to sea across the city of Boston. The cloud, as I observed it, looking from the southwest and thus obtaining a view at right angles to the smoke, was formed at some little distance to the southeast of the fire, and over a part of the smoke, which rose up higher than the rest, as is shown in Fig. 1. It was distinctly a cumulus, but its base and a good deal of its main portion were often obscured by the smoke. Fig. 2 is intended to give some idea of what was observed as the second stage in the phenomenon. The whole body of the cloud has been carried to the southeast, further away from the fire, and the effect of the stronger upper winds is seen in the blowing forward of the top of the cloud. At this stage the cloud could plainly be seen to be dissolving as it descended to lower levels.

In Fig. 3 we have represented, to the right, the third stage of the cloud, which is now rapidly diminishing in size and being carried away by the wind, while nearer the fire a new cumulus has been formed. It was noted that the formation of the cumulus in its first position, as shown in Fig. 1 and at the left of Fig. 3, was intermittent. There was not always a cloud at that point, but one grew whenever there was an especially active ascent of the smoke, and the position of this first cloud, at its beginning, was always the same with reference to the fire and the trail of smoke.

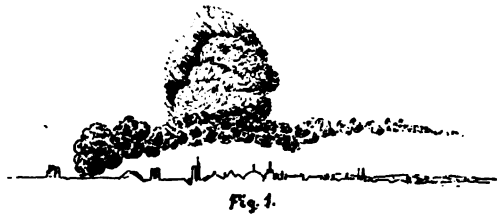

Fig. 1.

Fig. 2.

Fig. 3.

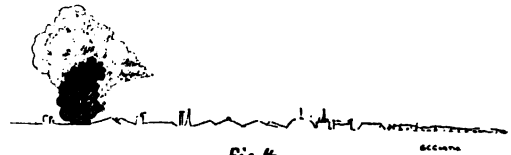

Fig. 4.

There seems little need of comment on this simple but interesting phenomenon. The conditions for cloud formation were not reached vertically over the fire, for the smoke was blown to leeward at once, and the warmed air did not rise high enough to reach its dew-point until it had been blown a-quarter or a-half of a mile to the southeast. For this reason Figs. 1, 2 and 3 show the cloud to the right of the fire. Looked at down the wind, *i. e.*, from the northwest, the appearance of smoke and cloud were as shown in Fig. 4.

It may be interesting to note in this connection the case of cloud formation over a fire mentioned by Espy in his *Fourth Meteorological Report*. The observer quoted by Espy was on the top of Mt. Monadnock, N. H., and saw the growth of a cumulus cloud over a fire of brush on the lowland. The cloud increased in size, and finally gave a shower of rain over a limited area.

The accompanying figures were drawn by

Mr. G. C. Curtis, Assistant in the Physical Geography Laboratory of Harvard University, from his own observations and after sketches made by the writer. R. DEC. WARD.

HARVARD UNIVERSITY,
December 19, 1896.

COMPLIMENT OR PLAGIARISM?

OUR attention has been called to a communication from Professor George Bruce Halsted in a recent number of SCIENCE in which he says that we '*took*' a whole block of problems and a long note from Halsted's Elements of Geometry.

If Professor Halsted had only printed in parallel columns extracts from Halsted's Elements of Geometry and the corresponding paragraphs in Beman and Smith's Plane and Solid Geometry, his charge of plagiarism would have fallen to the ground. For those, however, who have not the two books at hand, it may be worth while to make a few comments upon his accusation.

The *order* of the problems: To bisect a perigon; to trisect a perigon; to divide a perigon into five equal angles; to divide a perigon into fifteen equal angles, etc., is so natural that for this Professor Halsted will surely claim no originality. The same order may be found in Newcomb's Elements of Geometry, an earlier book than Halsted's.

Does Professor Halsted claim that we '*took*' our *solutions* from his book? A comparison will show only such resemblances as are inevitable when two authors are dealing with the same material.

It must then be the *terminology*, and especially the word '*perigon*,' which we have been guilty of appropriating. A modern treatment of the subject of angles requires the use of single terms for the angle formed by a half revolution of the moving arm and the angle formed by a complete revolution. To designate the former the term straight angle is now fully established; for the latter we had a choice among such terms as round angle, circum-angle, perigon, full angle, closed angle. After due consideration we chose 'perigon,' a word given in both the Century and Standard Dictionaries, and found in several geometries, among them Faifofer's (*perigono*).

Finally Professor Halsted lays especial emphasis upon the long note which we '*took*' from his Elements. We quote the two notes in full.

HALSTED.

REMARK.—From the time of Euclid, about 300 B. C., no advance was made in the inscription of regular polygons until Gauss, in 1796, found that a regular polygon of 17 sides was inscriptible, and in his abstruse Arithmetic, published in 1801, gave the following:

In order that the geometric division of the circle into n parts may be possible n must be 2. or a higher power of 2, or else a prime number of the form 2^m+1, or a product of two or more different prime numbers of that form, or else the product of a power of 2 by one or more different prime numbers of that form.

In other words, it is necessary that n should contain no odd divisor not of the form 2^m+1, nor contain the same divisor of that form more than once.

Below 300 the following 38 are the only possible values of n: 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 17, 20, 24, 30, 32, 34, 40, 48, 51, 60, 64, 68, 80, 85, 96, 102, 120, 128, 136, 160, 170, 192, 204, 240, 255, 256, 257, 272.

BEMAN AND SMITH.

NOTE.—That a perigon could be divided into 2^n, $3\cdot2^n$, $5\cdot2^n$, $15\cdot2^n$ equal angles was known as early as Euclid's time. By the use of the compasses and straight edge, no other partitions were deemed possible. In 1796 Gauss found, and published in 1801, that a perigon could be divided into 17 and hence into $17\cdot2^n$ equal angles; furthermore, that it could be divided into 2^m+1 equal angles if 2^m+1 was a prime number; and, in general, that it could be divided into a number of equal angles represented by the product of different prime numbers of the form 2^m+1. Hence it follows that a perigon can be divided into a number of equal angles represented by the product of 2^n and one or more different prime numbers of the form 2^m+1. It is shown in the Theory of Numbers that if 2^m+1 is prime m must equal 2^p; hence the general form for the prime numbers mentioned is 2^p+1. Gauss's proof is only semi-geometric, and is not adapted to elementary geometry.

Of course Professor Halsted is aware that from the days of Young, possibly earlier, in his Elements of Geometry, 1827, up to the present the substance of Halsted's 'long note' has been given in the better geometries, as witness Baltzer, Henrici and Treutlein, Chauvenet, Newcomb.

Professor Halsted's motive in making his charges we leave for others to determine.

BEMAN AND SMITH.

VOLCANIC DUST IN SOUTHWESTERN NEBRASKA AND IN SOUTH DAKOTA.

APROPOS of Prof. Salisbury's note on the subject in SCIENCE of December 4th, I would call attention to the fact that the occurrence of volcanic ashes in southwestern Nebraska has long been known. At the same time, notices of present exposures are of value. The deposit was at first called 'geyserite' by Prof. S. Aughey before 1880. References to the subject will be found as follows: 'Sketches of Physical Geography and Geology of Nebraska,' 1880, by S. Aughey: American Geologist, Vol. I., p. 877, and Vol. II., pp. 64 and 437; Proceedings

U. S. National Museum, Vol. VII., p. 99; Am. Journal of Science, Sept., 1886. These refer to the region in question. Closely similar deposits have been found as far east as Omaha, and as far north as the Missouri River in Knox Co., Neb.

An interesting and important question which should be kept in mind by those observing these deposits is whether there is more than one horizon shown at any one locality. Thus far I think no one has reported more than one, and it may be that all are to be referred to one eruption. If so the deposit becomes a most important reference horizon.

As a related item of intelligence I may add that this last summer I discovered a deposit of somewhat similar character extending a dozen miles or so along the South Fork of White River, in Lugenbeel Co., S. D., showing a thickness in places of more than 10 feet. This deposit is, however, of a light green color, coarser than that of Nebraska and more consolidated than I have seen there. Moreover it seems to mark the transition from the White River epoch to the Loup Fork.

J. E. Todd.

State University,
Vermilion, S. D.

SCIENTIFIC LITERATURE.

GRASSES OF NORTH AMERICA.*

The botanists of this country have been looking forward with interest for several years to the publication of the second volume of Dr. Beal's 'Grasses of North America.' Single-handed and alone, away from the larger libraries and collections, Dr. Beal has patiently and persistently carried forward the work which he has finally brought to completion and presented to the public in the volume before us. Much interest attaches to the work, for we have here presented, for the first time, in a single volume, descriptions of all the grasses of the United States and northward, which the writer was able to obtain, together with those which have in recent years been collected in Mexico by Mr. C. G. Pringle and Dr. E. Palmer. No work of similar character has before been published, and those wishing to find descriptions of our grasses, excepting for limited areas, have been obliged to consult numerous publications through which the descriptions were scattered. The total number of species described in the work, including introduced species and those cultivated for use or ornament, is 912, covering 659 pages. With few exceptions, these descriptions, which are very full, have been originally drawn up by the author. The nomenclature adopted is that of the so-called 'Rochester code,' and in every case full citations of authorities are given, considerable space being devoted to synonymy.

The author states in his preface that "it has required some courage and persistence to adhere to the work so long, realizing fully that it must contain many defects, and that perhaps its chief use would be to serve as a basis for others to enlarge in the future, correct and otherwise improve." This is very often the fate of scientific publications, and no one can hope to produce a work of any considerable extent which shall be beyond criticism or entirely free from errors. The work before us is no exception to this statement, and the criticisms or corrections here given are made in the kindliest spirit, with the intent of calling attention to some of the more important mistakes, hoping thereby to enhance the usefulness of the work, rather than discredit its value.

Collectors in preparing their labels occasionally overlook the importance of carefully noting the locality and station of the specimens gathered, and more often still they fail to note the date of collection or altitude. It is almost discouraging, and even annoying sometimes, to look over a dozen or more sheets of specimens and find nothing more definite in regard to these particulars than the name of the State—it may be 'Texas,' or again, the 'Rocky Mountains.' The author meets here a condition of things which places him at a disadvantage—by rendering his work incomplete—with the reader or student of biology, a position which might have been avoided by a trifling effort on the

**Grasses of North America*, by W. J. Beal, M. A., M. S., Ph.D., Professor of Botany in the Michigan Agricultural College, Vol. II. The grasses classified, described, and each genus illustrated, with chapters on their geographical distribution and their bibliography. Henry Holt & Company, New York.

part of the collector. The effect of this want of care in preparing labels is manifest in the work under consideration, in which the geographical distribution of the species is given, but the range is often limited to the material examined by the author. Errors in the recorded distribution of plants may, and often do, arise from incorrect determinations of species. There is an example of this given under *Danthonia sericea* Nutt., the range of which is recorded as 'New England to Florida, Colorado and California.' This species does not occur west of the Mississippi, the Western grasses referred to it belonging to other species. The occurrence of *Alopecurus alpinus* within the limits of the United States is doubtful. The specimens from the Rocky Mountains in the National Herbarium referred to that species are all *A. occidentalis* Scribn. *Sporobolus beevifolius* (Nutt.) Scribn. (*Vilfa cuspidata* Torr.) does not occur east of Ohio; there are no specimens in the National Herbarium from east of Missouri and Minnesota. The grass from Northern Maine referred to this species is a slender form of *Sporobolus depauperatus* named by Trinius *Vilfa richardsonis*. This form extends westward to the Rocky Mountains.

The scientific author employs figures to illustrate facts or to more clearly demonstrate his written statements. The author and not the artist is held responsible for their correctness. The reader has little interest in the artist unless his work possesses some special merit for which he has received general recognition, such as accuracy gained through a knowledge of the subject illustrated. This matter is here referred to because of the constant citation by the author of 'Grasses of North America,' of the draughtsmen who executed the figures used by him, and because of a few mistakes which these citations apparently render the present writer in some degree responsible.

Fig. 11, on page 35, is *Blepharidachne kingii* (S. Wats.) Hackel (*Eremochloe kingii* S. Wats.) and not *Eremochloa leersioides* (Munro) Hack. *Blepharidachne* is a genus of two species closely related to *Triodia*, and is omitted from the work.

Fig. 20 on page 77 is not *Arundinella palmeri* as stated. A, in the figure, is a spikelet of *A. brasiliensis*; a, is the floret of the same. B, is a spikelet of *A. deppeana*, and b, a floret of the same.

Fig. 22, on page 96, does not illustrate *Paspalum floridanum*, but is the reproduction of a drawing copied in part from Trinius and designed to illustrate *P. setaceum* Michx.

Fig. 37, on page 178, is incorrectly explained. A, is a spikelet of *Homalocenchrus oryzoides*, and a, is a spikelet of *H. monandrus*, and not a floret of *H. oryzoides*, as stated.

Fig. 41, page 229, illustrates a spikelet of *Stipa richardsonii* Link, and not *Oryzopsis macounii* (Scribn.) Beal. *Stipa richardsonii* Link appears to have been omitted from the work.

Fig. 53, on page 316, is said to be '*Epicampes macroura*.' The drawing was made to illustrate a spikelet of a grass (No. 3335 Pringle) which was doubtfully referred to *Epicampes bourgaei* Fourn., described on page 310.

Fig. 109, on page 525, was drawn by Scribner, but figure 81, on page 440, designed to illustrate *Opizia stolonifera*, was not.

Fig. 76, on page 527, is not '*Bouteloua texana*,' but *Bouteloua trisena* Scribn. in Proc. Acad. Nat. Sci. Phila. (1891), p. 307.

Fig. 117, on page 627, illustrates parts of a spikelet of *Brachypodium pinnatum* var. *cæspitosum* (No. 3443 Pringle), described in Proc. Acad. Nat. Sci. Phila. (1891) p. 305, and not *B. mexicanum*, as stated.

Fig. 118, page 632, illustrates some parts of *Jouvea pilosa* (Presl) Scribn., and not *Jouvea straminea* Fourn., which is figured in Bull. Torr. Bot. Club, 23 : pl., 266.

There are in the work about 160 new names, specific and varietal, arising partly from the system of nomenclature adopted, partly from the shifting of species from one genus to another and the reduction of species to varieties, or the elevation of varieties to species, and partly from the publication of new species. There are about forty species named and described, which have heretofore been unpublished, or at least unidentified, and are presumably new species. These are chiefly Mexican grasses, and, for the most part, occur in the collections of Mr. C. G. Pringle, the names in nearly all cases being those under which the species were distributed. Among the species described as new are the following :

Andropogon geminata Hackel ined.
Arundinella palmeri Vasey ined.
Paspalum pittieri Hackel MS. = Pringle 2359.
Panicum sonorum Beal.
Panicum vaseyanum Scribn. ined. = 1435 Pringle.
Pennisetum durum Beal. = 498 and 817 Pringle.
Stipa multinode Scribn. ined. = 385 Pringle.
Oryzopsis pringlei Scribn. ined. = 4759 Pringle.
Muhlenbergia pulcherrima Scribn. ined. = 1416 Pringle.
Muhlenbergia firma Beal. = 4914 Pringle.
Muhlenbergia nebulosa Scribn. ined. = 2366 Pringle.
Muhlenbergia elongata Scribn. ined. = 398 and 3477 Pringle.
Muhlenbergia brevifolia Scribn. ined. = 4736 Pringle.
Muhlenbergia laxiflora Scribn. ined. = 1412 Pringle.
Muhlenbergia strictior (Scribn.) = 1418 Pringle.
Sporobolus macrospermus Scribn. ined. = 2447 Pringle.
Epicampes anomala Scribn. ined. = 1423 Pringle.
Calamagrostis erecta Beal (*Calamagrostis plumosa* Scribn. ined.) = 4726 Pringle.
Calamagrostis pringlei (Scribn.).
Calamagrostis lactea Beal. = 1022 Suksdorf.
Trisetum filifolium Scribn. ined. = 1431 Pringle.
Trisetum sandbergii Beal. sp. nov.
Eragrostis pusillus Scribn. ined. = 2327 Pringle.
Eragrostis erosa Scribn. ined. = 415 Pringle.
Eragrostis plumbea Scribn. ined. = 2311 Pringle.
Melica parishii Vasey ined.
Poa vaseyana Scribn. ined. Too near *P. wheeleri* Vasey.
Poa subaristata Scribn. ined. (Macoun's Catalogue, without description) = 633 Tweedy.
Poa acuminata Scribn. ined.
Colpodium mucronatum (Hackel).
Graphephorum pringlei Scribn. ined. = 4765 Pringle.
Festuca howellii Hackel in herb.
Festuca vaseyana Hack. ined.
Festuca dasyclada Hack. ined.
Bromus laciniatus Beal. = 4897 Pringle.
Brachypodium pringlei Scribn. ined.
Hordeum montanense Scribn. ined.
Elymus innovatus Beal.

Several species described are presented in a manner that might lead one to infer they were published here for the first time. Among these are: *Paspalum inops* Vasey, published in 1893 (Contr. U. S. Nat'l. Herb. 1. 65); *Atropis uniaterale*, published and figured in 1893 under *Poa* (Vasey in Grasses of the Pacific Slope, t. 85); *Agrostis inflata* Scribn., published in 1894 in the Canadian Record of Science, where also was published *Poa trivialis* var. *filiculmis* Scribn. *Andropogon floridanus* was published in a Bulletin of the Torrey Botanical Club, 23: 145 (1896). It is unfortunate that unpublished names should in any case have been cited as synonyms, as the citation has no significance, and the publication here prevents their possible future use. The grasses cited under *Panicum indicum* are *P. phleiforme* Presl, a species very closely allied, to and perhaps not distinct from, *P. indicum*. *Chamæraphis* is taken up for *Setaria*, and made to include *Panicum sulcatum* Aubl., which belongs to the section *Ptychophyllum* of *Panicum*, while *Panicum palmeri* and *P. reverchoni*, the first a species of *Ixophorus*, the latter a *Setaria*, are described under *Panicum*, and classed in the section *Ptychophyllum*. *Panicum schiedeanum*, described on page 119, is also an *Ixophorus*, closely related to the species described as *Panicum palmeri*. *Chamæraphis latiglumis*, described on page 152, is not a *Setaria*, but belongs to a distinct genus, named *Setariopsis* (see Scribn. Pub. Field Col. Mus., Bot. Ser., I.: 288 (1896)). '*Chamæraphis caudata* var. *pauciflora* Vasey ined.,' for which 191 E. Palmer is cited, is a small form of *S. Liebmanni* Fourn. The synonyms cited under *Chamæraphis uniseta* are incorrect for No. 381 E. Palmer, the grass referred to. *Setaria uniseta* Fourn. and *Urochloa uniseta* Presl are *Ixophorus unisetus* Schlecht., the species described under *Panicum palmeri* on page 120. '*Muhlenbergia lycuroides* Vasey ined.,' described on page 239, for which 489 E. Palmer is cited, is again described on page 271, under the name *Lycurus phleoides* var. *brevifolius* (Scribn.). *Pereilema* Presl, described on page 271, is cited as a synonym under *Agrostis* on page 320. *Sporobolus depauperatus* var. *filiformis* Beal, on page 296, characterized as having 'the culm 10 to 12 cm. long, exserted for more than half its length; panicle much reduced, 2 cm. long,' is *Sporobolus gracillimus* (Thurb.). *Sporobolus ovatus* Beal, for which *Sporobolus minor* Vasey is sited as a synonym, simply adds another synonym to *Sporobolus vaginæflorus* (Torr.). *Calamagrostis vaseyi* Beal, page 344, is certainly *Calamagrostis purpurascens* R. Br., a species quite distinct from *C. sylvatica* of Europe. *Calamagrostis sylvatica* var. *americana* Vasey, described on p. 347, is the same. *Spartina*

densiflora, described on p. 397, is the same as *S. junciformis* Engelm. & Gray, described on page 400. *Bouteloua ramosa* Scribn. is described on page 416, and again on page 418 it appears as a variety of *Bouteloua oligostachya*. *Leptochola polygama* (Fourn.), described on page 437, is the same as *Gouinia polygama* Fourn., a species identical with *Bromus virgatus* Presl. *Gouinia* appears to be a well established genus, and the grass in question should be named *Gouinia virgata* (Presl). *Eragrostis pallida* Vasey, described on page 479, is not distinct from *E. glomerata* (Walt.), *E. conferta* Trin., described on page 481, but it is very unlike *Ergroastis alba* Presl, the type of which has been seen by the writer. Under *Atropis fendleriana* (Steud.) is included under *Poa arida* Vasey, which is a distinct and well marked species, as are *Poa eatoni* S. Wats. and *Poa lucida* Vasey, also cited as synonyms, although the latter is very close to *Poa buckleyana* Nash. *Atropis lævis* (Vasey) is, as stated, *Poa lævis* Vasey, but that name should be changed to *Poa lævigata*. '*Festuca rubra* var. *pubescens* Vasey ined.' is the same as *Bromus secundus* Presl, and *Festuca richardsonii* Hook., *Bromus barbatoides* Beal, page 614, is *Bromus trinii* Desv. Ramaley, and not R. Pound, ought to be cited after *Agropyron violacescens* on page 635, and after *Agropyron caninoides* on page 640. *Agropyron violacescens* is *Agropyron richardsoni* Schrad. '*Agropyron glaucum* (Desf.),' page 637, is *Agropyron spicatum* (Pursh). *Poa brandegei* Scribn. in herb.,' page 544, is the same as *Poa lettermani* Vasey, described under *Atropis* on page 579. Under *Atropis pringlei* (Scribn.), page 578, *Poa pattersoni* Vasey is erroneously cited as a synonym.

There are keys to the genera under all the tribes with the exception of Hordeæ, and there are also keys to the species under the genera. The difficulty of making keys is appreciated by all who have undertaken them, and the value of good keys is at once appreciated by those having occasion to use them. A clear conception of all the species of a genus, and a sufficient knowledge of their characters to be able to express briefly their most obvious points of difference or resemblance, is essential to the compilation of a good key. The test of a key of analysis is in its use. The writer has not attempted to use the keys in the work under notice, but it is evident that they have been prepared with much labor and painstaking care. In glancing them over one is struck by the very frequent use of measurements of glumes, awns or ligules, the dimensions of which are often too slight or too inconstant to be of much value in a diagnosis.

On page 237, under *Muhlenbergia*, in a considerable series of 'g,' there are:

g. Floral glume 2.5 mm. long, ligule 2–2.5 mm. long, awn 1 mm. long.....23
g. Floral glume 2–2.7 mm. long, ligule 2–3 mm. long, [awn] 1–3 mm. long.....24

Lower down on the same page, in a series 'h,' appears:

h. Floral glume 3.5 mm. long, ligule 1 mm. long, awn 10–15 mm. long.....33
h. Floral glume 3.5–2.5 mm. long, ligule 1 mm. long, awn 10–15 mm. long.....28

These distinctions are too slight to be of much assistance to the student in running down a species.

Considering the extent of the work and the conditions under which the author labored, it is remarkable that more errors have not occurred. In spite of the faults to which attention has been called, and others not noted, due, chiefly, to imperfect proof-reading—the difficulties of which in such publications few appreciate—the work is one of much value to systematic botanists, and indispensable to those engaged in the study of the large and very interesting family of plants treated.

F. LAMSON-SCRIBNER.

Race Traits and Tendencies of the American Negro. By FREDERICK L. HOFFMAN (Publications of the American Economic Association, Vol. XI., Nos. 1, 2 and 3. August, 1896. Pp. 1–329). The Macmillan Company. Paper, $1.25; cloth, $2.00.

This work is a mine of statistical information relating to the population, viability, anthropometry, and the racial, social and economic conditions of the negro in the United States and incidentally in the West Indies; and the figures, culled with evident care from the most trustworthy sources and collected through personal

effort, are intelligently and impartially combined and discussed in a clear and attractive manner, so that, despite the scores of statistical tables, the book is easy reading from preface to conclusion.

In the first chapter, which relates to the growth and movements of the black and mulatto population, it is shown that the negro has failed to gain a foothold in any of the Northern States as an agricultural laborer; that in general he has remained in the South, contrary to the many predictions of wholesale migration; and that he does not readily lend himself to schemes of colonization, and has failed miserably in the most recent experiment of the kind (in Durango, Mexico). At the same time it is shown that the negro displays a tendency to segregate in certain sections in the South, while in the North, and to a less extent in the South, there is a tendency toward congregation in the cities.

To students of the negro problem the second chapter, 'Vital Statistics,' is of paramount interest. Here the author tabulates and discusses the rates of birth and death under various conditions among the blacks and compares them with the corresponding rates among the whites, calculates the expectation of life for blacks and whites, and examines fully the causes of mortality in both races. Summarizing the facts, it is pointed out (1) that the excess of births over deaths is greater for the whites than for the blacks in the Southern States; (2) that in the Northern States the blacks do not hold their own, since the deaths outnumber the births, the apparent increase in population being due to migration; (3) that for ten representative Southern cities the death rate for five years (1890–'94) was 20.12 per thousand for the whites, and 32.61 for the blacks, indicating a steady and apparently irresistible vital decline, both relative and absolute, on the part of the latter; (4) that the excess of negro mortality is greatest in the age period under 15 years, culminating among infants, and (5) that hence the number surviving to productive and reproductive ages is considerably less for the blacks than for the whites; (6) that the expectation of life among the blacks is from 12.5 to 17.11 years less than among the whites in the cities giving most reliable statistics; (7) that the rates of mortality among blacks and whites are not materially affected by other conditions than those of race and heredity; and (8) that since emancipation, mortality among the blacks has steadily increased, while the white death rate has diminished. It is shown that the chief causes of excessive mortality among the blacks are (1) diseases of infants, including premature and still births; (2) consumption, which is increasing among the blacks and decreasing among the whites; (3) pneumonia; (4) scrofula and venereal diseases, which are much more prevalent among the blacks and which are increasing; (5) malarial fevers (contrary to general opinion); and (6) typhoid fever at the earlier ages. The observations collated indicate that smallpox is more prevalent among the blacks, chiefly through greater neglects of vaccination; that scarlet fever, yellow fever, appendicitis and carcinoma uteri, from all of which the negro is generally supposed exempt, occur, but less frequently than among the whites, as is the case also with insanity, suicide, measles, diphtheria, tumor-cancer and alcholism; while the mortality from childbirth and puerperal fever is greater among the blacks by reason of ignorance and maltreatment. "The general conclusion is that the negro is subject to a higher mortality at all ages, but especially so at the early age periods. This is largely the result of an inordinate mortality from constitutional and respiratory diseases. Moreover, the mortality from these diseases is on the increase among the colored, and on the decrease among the whites. In consequence, the natural increase in the colored population will be less from decade to decade, and in the end a decrease must take place. It is sufficient to know that in the struggle for race supremacy the black race is not holding its own; and this fact once recognized, all danger from a possible numerical supremacy of the race vanishes" (page 148).

The third chapter is devoted to anthropometric facts, figures and opinions derived from various sources. The figures indicate that the weight of the black is somewhat greater and his stature somewhat less than the weight and stature of the white of the same class; that the lung capacity in the black is considerably less and

the frequency of respiration somewhat greater than in the white; that the lifting strength of the white is the greater, and that the vision of the black is inferior, though he is less liable to disease of the eye. The impressions and opinions of various students appear to indicate that during slavery the black was 'physically the equal if not the superior of the white, and this view has been fully sustained by the statistics of mortality, which also ranked him the equal if not the superior of the white thirty years ago' (pages 175–6); but that since emancipation the black has deteriorated materially, both in physical development and in viability. "And the opinion is warranted that * * * the tendency of the race has been downward. This tendency, if unchecked, must in the end lead to a still greater mortality, a lesser degree of economic and social efficiency, a lower standard of nurture and a diminishing excess of births over deaths. A combination of these traits and tendencies must in the end cause the extinction of the race" (page 176).

The fourth chapter deals with 'Race Amalgamation' in a statistical way, so far as the available data permit, but with abundant references to the opinions of students. It is recognized that the American negro 'is largely a cross between the African and the white male' (page 177), and that very little pure African blood remains; it is also recognized that, since the emancipation, the admixture of the races has been materially checked and is constantly diminishing, with a concomitant tendency toward the development of a distinctive race of mixed blood, to which the foregoing facts and figures apply, and of which the before-mentioned features and tendencies are characteristic. It is shown that the roseate dreams of radical Abolitionists thirty years ago concerning the absorption of the blacks, with attendant improvement in the whites, have faded as time has widened the chasm between the races; the shocking immorality of the blacks, as indicated by illegitimate births in Washington and elsewhere, is set forth in the records; and the physical deterioration of the black race is, at least implicitly, ascribed to the moral inferiority.

Under 'Social Conditions and Tendencies' it is shown that the blacks take kindly to religious institutions, though education pervades their ranks more slowly, and that neither counteracts criminal tendencies so completely as has been hoped; it is also shown from ample statistics that crime is nearly thrice as prevalent among the blacks as among the whites, this relation holding even when the negro is compared with the most criminal nationalities. The statistics for different cities and sections appear to indicate also that crime is increasing among the blacks, though decreasing among the whites. A considerable body of data relating to lynching has been brought together, which seems to indicate that neither this summary mode of punishment nor the crimes for which it is the penalty are decreasing. Efforts are made also to tabulate the statistics of pauperism, and the tables indicate the great preponderance of pauperism among the blacks, though it is evident that the figures do charitable justice to this phase of the character of the alien race. Under 'Economic Conditions and Tendencies' the negro is considered as an agricultural laborer and as an industrial factor, and it is shown that he profits little, and, according to many opinions, suffers from education, and displays a lamentable lack of thrift and public spirit as a citizen, though filling fairly well a subordinate position in industrial society.

In the final chapter (a 'Conclusion' in name and in the fact that it ends the book, though not at all as a summary of the investigation) comparisons are instituted between the American negro and various other races, including the American Indians, the Maoris, etc.; the author not only concurring in, but adding weight to, the general opinion concerning the decadence of the lower races when brought in contact with the higher.

From a sociologic point of view, if not from that of the statician or economist concerned with great masses rather than inconspicuous (albeit important) principles, a criticism may be lodged against the book; and it may be stated the more starkly, *first*, because all or nearly all current statistical discussions of the subject are open to the same criticism, and *second*, because another Federal census is in contemplation, and it would seem especially timely to direct atten-

tion toward a little-considered factor in the negro problem. The author justly points out that during the days of slavery the amalgamation between the whites and blacks was illicit, and that the mulattoes and other mixed bloods were almost exclusively the progeny of white fathers and black or mixed-blood mothers, and his discussion of the vital and other characteristics of the American negro is based on these conspicuous facts; and he justly observes that, with the abolition of slavery, illicit amalgamation decreased enormously, and, so far as fruitful unions are concerned, has practically disappeared. He also gives slight recognition to the fact that amalgamation is proceeding slowly through intermarriage; yet he does not notice (although his statistics clearly indicate as much) that by far the greater part of the legitimate and productive unions are between black men and white women, rather than between white men and black women, as during slavery. Thus in Michigan, during the 20 years 1874–1893, 111 out of the 14,151 marriages were interracial, and of these 93 were between black or mulatto males and white females, leaving only 18 unions of the slavery type (page 198); and in Rhode Island, during the 13 years 1881–1893, there were 51 white females and only 7 white males in the 58 interracial marriages (page 199). So too, in the 23 cases of interracial marriage (excluding the sporadic unions) studied by the author, there were 19 white women to 4 white men (page 204). These ratios are in accordance with the casual observations of the reviewer, who has noted in addition (again leaving out of account sporadic and irregular unions) that many of the blacks who marry white women are among the leading representatives of their race, one being the most illustrious in American history, while in some cases at least the white wives are fairly representative of their race and sex. Now a question at once arises concerning the characteristics of the progeny of such unions, who may not be numerous but who represent a distinct class of our population; a question arises also as to whether these legitimate interracial unions are increasing, as the meager figures appear to indicate; and there are half a dozen collateral inquiries which will occur to sociologists, and perhaps to those statisticians who, like the author of the memoir under notice, are given to considering the meanings expressed by figures as well as the figures themselves. This criticism, it will be observed, is of the constructive rather than the destructive sort; it does not tend to invalidate any of the results of Mr. Hoffman's excellent work, but, if well founded, indicates a direction in which the work might have been carried further advantageously.

W J McGee.

Les Aryens au Nord et au Sud de l'Hindou-Kouch. Par Charles de Ujfalvy. pp. 488. G. Masson, Paris. 1896.

M. Ujfalvy is known as a diligent student of anthropology and an earnest disciple of Broca. He has the same implicit faith in the permanence of the physical type and its superiority over all other human traits for the purposes of classification and tracing descent. The feature beyond others, which he considers ranks in significance, is the cranial index. A nation, he observes, may lose its language, alter its social condition and deeply modify its blood by crossings; but it will always preserve the traces of its primitive physical type. Only through a long process of transformation, by which the encephalon is materially altered in its lines of growth, and thus changes the shape of its bony envelope, can a brachycephalic people, for instance, become dolichocephalic.

These are the leading principles of investigation which the author proceeds to apply to the Aryan tribes of Central Asia. The main topic is preceded by two introductions, the first geographic and historic, the second 'ethnologic, ethnogenic and biologic.' The former not only describes the geographic features of the region and its trade routes, but lays especial stress on the great *loess* formations and their bearings on human character and distribution. The primitive Aryan Iranians, he argues, were immediate neighbors to the ancestors of the Chinese.

The second introduction is largely historical. The author points out the wide variance in the skull-types of the modern Asian Aryans and seeks to explain it by various invasions and interminglings in ancient times, and biologic laws—ever faithful to his motto: "Il existe

dans chaque race un type crânien qu 'il s'agit de retrouver."

The remainder of the work is divided into three parts. The first is devoted to the Aryans north of the Hindu Kusch range. These include the Galtchas, the Tadjiks of the mountains and the plains, the Iranians of the Pamir, and various lesser conglomerations, as the Kashgars, the Darvasis and the Karatheghins. Each of these is conscientiously studied, not merely from the physical side, but including their dialects, religions, governments, history and civilization. Free use is made of other writers, and it must not be forgotten that the author has extensive sources of personal observation, his wide travels in Central Asia having provided him with abundant material.

The second part takes up the tribes of Dardistan, Baltistan and Kafiristan, with similar thoroughness. Especial attention is paid to their religions and castes, the influence of Mazdeism and Buddhism, their sociologic customs and the differences between the Aryan dialects north and south of the Hindu Kusch. Incidentally, many other questions of anthropology are mentioned. For instance, he assigns to the Dravidas of India a 'half-mongolic' origin (page 240), which thus explains their agglutinative languages. (This overlooks the quite different system of their agglutination.) In this part much use is made of the observations of Leitner and Risley, and the researches of Ratzel and Biddulph.

The third part is an epitome of his conclusions. A careful statement is presented of the physical traits, especially those of the crania. His inference is positive that the *Homo Europæus* never had his birthplace in Central Asia, as his corporeal type is nowhere found there. The Hindoo, of Hindustan, may be a homologue of the Mediterranean type.

A first appendix follows on the early Bactrian and Scythic coinage, of great interest to the historian and numismatist, and a second on the anthropologic terminology adopted by the author. A moderately well drawn and not very clear ethnographic map is appended.

The work deserves high recommendation. It is learned and fair, rich in information not easily accessible. Some will find it in a too exclusive adherence to physical standards of ethnic comparison; but that is the author's avowed position.

D. G. BRINTON.

SCIENTIFIC JOURNALS.

THE MONIST.

THE bulk of the contents of the January *Monist* is occupied by three long and exhaustive articles: (1) 'The Logic of Relatives,' by C. S. Peirce; (2) 'Animal Societies,' by Paul Topinard; (3) 'The Philosophy of Buddhism,' by Paul Carus.

Mr. Peirce's article is his first publication on the subject of the logic of relatives since 1884, and while devoting much space to a critical analysis of parts of Schröder's new volume is still comprehensive enough to embrace an independent exposition of the theory of graphs, of dyadic relatives, and offers for the first time Mr. Peirce's rules for working with the 'General Algebra of Logic.' New diagrams and improvements of characters are introduced, and finally certain important mathematical developments in the combinatorial analysis are given.

Dr. Topinard examines at considerable length the causes and forms of the various social assemblages met with in the animal world, and his conclusions touch the important questions of the function of the various instincts, the rôle of the family, etc., in the formation of animal society, as well as directly develop a distinction between 'colonies' and societies, profoundly affecting that doctrine which bases sociology on biology.

Finally, in *The Philosophy of Buddhism*, Dr. P. Carus seeks to reveal the scientific kernel of ancient Buddhistic thought, compares its results to the doctrines of modern psychology, animadverts upon Oldenberg's philosophical interpretation of Buddha's doctrines, and closes with a psychological elucidation of the doctrine of Nirvâna.

Prof. J. M. Tyler discusses Cope's *Primary Factors of Organic Evolution;* the usual French correspondence, and reviews of Ostwald's scientific classics and of works by Cantor, Griesbach, Freycinet, etc., appear; while in Discussions we have remarks upon *Panlogism*, by E. Douglas Fawcett, and a mention of the proposed new scientific catalogue.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.—SECTION OF ASTRONOMY AND PHYSICS, DECEMBER 7, 1896.

Prof. J. K. Rees gave a very interesting review of the work of Newton, Evans and others upon the probable orbit and period of the great shower of meteors which were seen in 1833 and 1866, and which are soon due again. Attention was also called to the work of Leverrier, and Opholtzer in finally settling the period of this swarm at about 33¼ years. At the request of Prof. Stone observations were made at all the large observatories, on the night in November, to see if by chance an unusual number of meteors should be observed, thus indicating that the swarm had so scattered out that some of the advanced guard would appear even three years ahead of the general mass. The number observed by Prof. Rees was no greater than normal and the results were rather negative.

H. C. Parker, upon a universal method of measuring current, showed how it is possible and convenient to measure currents varying from a fraction of a microampere to a megalampere, *i. e.*, from, say a hundred millionth, to a million amperes, simply using a voltmeter, or a delicate galvanometer, in connection with a series of shunts. He exhibited a series of such shunts ranging from 0.1 ohm to 0.00005 ohm which had been determined with the double bridge with an error not to exceed 0.1%.

W. Hallock then exhibited some mechanical devices by means of which it is possible to illustrate the interference of two beams of light with any desired phase difference, and another showing how a beam of plane polarized light is resolved into two beams at right angles to each other on entering a double-refracting medium.

Dr. T. A. Humason reported upon the meteors seen on December 4th, as follows: While riding in Central Park opposite West Seventy-second Street, at twenty minutes to five, on the afternoon of December 4th, I saw a meteor so brilliant as to be plainly visible, though it was then about sunset and quite light. The meteor caught my attention at an altitude of fifty degrees, a little south of east, and descended almost vertically and with rapid motion, until it reached an altitude of fifteen degrees, when it disappeared. The head had a diameter of about fifteen minutes and was very clearly defined. A train, two or three degrees in length, was also visible. The eastern sky was almost covered with clouds and the meteor seemed to be between them and myself, though it is probable that it was above the clouds and was seen through them. The meteor vanished in mid-air, without passing behind any intervening object, and as meteors are usually extinguished within five or ten miles of the earth it seems probable that this was near the end of its journey and not far above the city.

At the same time people on Brooklyn bridge observed a meteor in the northeastern sky. It is possible that these were one and the same; and if so, owing to the difference of direction from the two points of observation, the meteor must have been very near. But it is quite possible that the observers on Brooklyn bridge were looking at a different meteor, for another was seen at the same time from Fordham, and directly east of that place, which would have been visible in the northeastern sky from Brooklyn bridge.

At the time these meteors were seen, another was observed passing over Passaic, N. J., and moving eastward; another over Irvington-on-the-Hudson, moving northeastward, and one over Danbury, Conn., also traveling in a northeasterly direction. It is evident that this was not a single meteor seen from these several places, but that there were several meteors traveling in slightly different directions. As large meteors seldom or never travel in groups and as they are usually shattered near the end of their course, it is probable that this came into the atmosphere a single, large meteor and that it burst not far from here, the fragments taking slightly different directions. All of these observations would be satisfied by the following hypothesis: Passaic, Irvington and Danbury are almost in a straight line. It is probable that the meteor approached this neighborhood, passing over Passaic and moving eastward; that immediately after passing Passaic it separated into three or more parts, one turning slightly to the north and passing over Irvington and Danbury, another continuing in a straight line and passing over Fordham, and a third turning

slightly south and passing over New York. Another report states that a meteor was also seen over Rahway, N. J., which burst and came to the ground in four parts. This was probably another offshoot from the same original, and must have left it, if this hypothesis is correct, before it reached Passaic.

W. HALLOCK,
Secretary of Section.

SECTION OF BIOLOGY, DECEMBER 14, 1896.

PROF. J. G. CURTIS, Chairman, in the chair.

Dr. Arnold Graf made a preliminary report on 'Some New Fixing Fluids.'

Mr. J. H. McGregor read a paper entitled 'An Embryo of *Cryptobranchus*.' The embryo described is about 16 millimetres long, and is the first to be recorded of this species. Prominent among its external features are the excessive amount of yolk, the marked ventral flexure in the cervical region and the very early and almost simultaneous appearance of the two pairs of limbs. The dorsal surface is pigmented, the pigment cells being arranged in transverse bands, one band over each metamere of the body. Lateral line sense-organs can be distinguished. Among the most striking internal characters may be mentioned the dorso-ventral flattening of the notochord, the late appearance of entoderm and alimentary organs generally, due doubtless to the great mass of the yolk. The primordial skull is unusually well developed. The auditory vesicle has an endolymphatic duct ending blindly immediately under the skin on the top of the head. Along the sides of the body a system of organs occurs which are probably homologous with the embryonic sense-organs described by Beard in the sharks.

Dr. J. L. Wortman spoke of the *Ganodonta*, a new and primative suborder of the Edentata from the Eocene of North America. One section or family of the suborder, viz: the *Stylinodontidæ*, is composed of *Hemiganus*, *Psittacotherium*, *Ectoganus* and *Stylinodon*, and forms a closely connected and consecutive phylum, reaching from the base of the Puerco to the Bridger formation and leading directly to the Gravigrada or ground sloths. A second family, viz: the *Conoryctidæ*, composed of *Conoryctes* and *Onychodectes*, may be regarded as ancestral to the Armadillos. The character and origin of the Edentate fauna of South America was discussed at length and the conclusion reached that its original home was in North America. It was further held that there was a migration to the southward before the close of the Eocene and that there must have then been an early land connection between the two continents.

C. L. BRISTOL,
Secretary.

THE AMERICAN CHEMICAL SOCIETY.

THE regular meeting of the New York Section of the American Chemical Society was held, by invitation of Drs. Morton and Leeds, at the Stevens Institute of Technology, Hoboken, on the 11th inst.

An unusually large representation from the Society's membership gave attention to the proceedings.

Dr. Leeds described the development of methods for the quantitative estimation of micro-organisms in waters with especial reference to the study and control of discolorations and offensive odors in water supplies, such as afflicted the city of Brooklyn in the summer just passed; a matter entirely distinct from the bacteriology of water in a pathogenic sense, and, therefore, in nowise at issue with work of that character.

Dr. Leeds recommended that engineers in charge of water supplies should familiarize themselves with the simple apparatus and manipulation necessary to enable them to foresee the approach of conditions favorable to the growth of these micro-organisms productive of color and odor, and thus be enabled to take such steps as may be applicable to the hindrance or prevention of their development.

After the reading of Dr. Leeds' paper the Society was invited to adjourn to Dr. Morton's lecture room, where all preparations were complete for the very interesting and beautiful experiments which followed.

The causes of the phenomena of fluorescence were explained, and many illustrations given by the aid of solutions, colored screens and monochromatic light. Particularly striking were the effects produced by the substance

'Thallene,' isolated from petroleum residues some years ago by Dr. Morton.

Another adjournment to Dr. Morton's house, where the meeting was brought to a close with an informal reception.

The members present were united in their appreciation of Dr. Morton's hospitality, and the meeting must be recorded as one of the most enjoyable held by the New York Section.

DURAND WOODMAN,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held Wednesday, December 2d, forty-eight persons present. The evening was devoted to a commemoration of the life and services of Thomas Tracy Bouvé, who had died on June 3, 1896.

Dr. James C. White read a letter from Mr. Charles J. Sprague, recalling some of the prominent characteristics of Mr. Bouvé as a man, and of his business abilities and scientific attainments. Dr. White then read an appreciative review of Mr. Bouvé's long and important services to the Society and to science. Prof. Alpheus Hyatt spoke of Mr. Bouvé's work in the Society since 1870, and Prof. W. O. Crosby gave an account of Mr. Bouvé's contributions to scientific literature, and of his work in connection with the Society's collections of minerals, rocks and fossils.

A letter from Prof. James Hall, reminiscent of the early days of the Society and of the services rendered to science by Mr. Bouvé and several of his associates, was read; also letters from Profs. Goodale and Putnam.

SAMUEL HENSHAW,
Secretary.

THE ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

THE regular winter meeting of the Society was held in the city of Birmingham on Tuesday, December 15, 1896. Mr. Fred. M. Jackson, President of the Society, was in the chair, and ten members were present. A committee appointed at the last meeting to arrange for the collection, monthly, of statistics of the iron ores, coal, coke, limestone and other mineral resources and products of the State, reported by recommending a plan by which the collection of these statistics would be undertaken by Mr. W. M. Brewer, under the auspices of the Society and of the State Geological Survey. The plan recommended by the committee was adopted, and it is the intention to prepare monthly tables of statistics, to be furnished to such of the technical journals as may wish to publish them, and to be kept on file in the offices of the Secretary of the Society and of the State Geologist.

Two papers were presented, viz.: On Gold Milling in Clay County, Alabama, in the Idaho district, by Joshua Franklin, and on the Manganese Deposits of Georgia, by Wm. M. Brewer.

Mr Franklin gave the details of his recent experience in treating with profit the low-grade gold ores of Clay County with a Huntington mill, shaking coppers, blanket sluices and amalgam traps. The paper of Mr. Brewer was read by title only, being delayed in the mail.

After the reading of the papers there followed an instructive discussion of the subject of coke-making, Dr. Phillips, Mr. Jackson, Mr. Erskine Ramsay, Col. A. J. Montgomery and others taking part therein. The great importance of the recovery of the by-products of the coking ovens was particularly dwelt upon. This subject has often been discussed at previous meetings, and a number of experiments have been made at several points near Birmingham with a view to utilizing some, at least, of these now generally wasted products.

The next meeting, at which the officers for the ensuing year will be elected, will be held some time about the beginning of the summer months.

EUGENE A. SMITH,
Secretary.

NEW BOOKS.

Habit and Instinct. C. LLOYD MORGAN. Edwin Arnold, London and New York. 1896. Pp. 351.

Outlines of Psychology. WILHELM WUNDT. Translated by Charles Hubbard Judd. Leipzig, Wilhelm Engelmann. Pp. xviii+342.

Outlines of Electricity and Magnetism. CHARLES A. PERKINS. New York, Henry Holt & Co. 1896. Pp. viii+272.

Star Atlas. WINSLOW UPTON. Boston and London, Ginn & Co. 1896. Pp. iv+29 and plates.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, JANUARY 15, 1897.

CONTENTS:

A National Department of Science: CHAS. W. DABNEY, JR. 73
Geological Society of America: Ninth Annual Meeting, Washington, December 29–31, 1896: J. F. KEMP. 81
American Mathematical Society: F. N. COLE 99
Current Notes on Anthropology:—
Divinatory and Calendrical Diagrams; The Racial Geography of Europe: D. G. BRINTON 100
Notes on Inorganic Chemistry: J. L. H. 101
Astronomical Notes: H. J. 102
Scientific Notes and News 102
University and Educational News 107
Discussion and Correspondence:—
On Certain Problems of Vertebrate Embryology: J. BEARD, CHARLES S. MINOT 107
Scientific Literature:—
Bailey's Survival of the Unlike: CHARLES E. BESSEY. *Nuttall's Popular Handbook of the Ornithology of Eastern North America:* C. H. M. *Hertwig and Wilson on The Cell:* C. B. DAVENPORT. *Physiological Papers by H. Newell Martin:* S. F. LOCKE. *Behrens' Anleitung zur Mikrochemische Analyse:* E. R. 109
Societies and Academies:—
Chemical Society of Washington: A. C. PEALE. *The Texas Academy of Science:* FREDERIC W. SIMONDS 115
New Books 116

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A NATIONAL DEPARTMENT OF SCIENCE.

THE PRESENT ORGANIZATION OF THE SCIENTIFIC WORK OF THE GOVERNMENT, ESPECIALLY THAT DESIGNED TO DISCOVER AND DEVELOP THE RESOURCES OF THE COUNTRY, CONSIDERED WITH REFERENCE TO THE UPBUILDING OF SUCH A DEPARTMENT.

THE United States Government is doing more to discover the resources of its territory and to teach its people to develop them than any other government in the world. Our many noble establishments for the promotion of science, both pure and applied, are the admiration of all. Foreigners regard these institutions as the most unique feature of our government. They represent the true American idea. It is the more to be regretted, therefore, that this grand idea, so well established in our laws, is not adequately represented in the organization of the government.

The scientific work of the government is carried on by many agencies scattered through the various departments, the more important ones, however, being connected with the Treasury Department, the Navy Department, the Department of the Interior and the Department of Agriculture. Some of them are not connected with any department.

The majority of these bureaus have no logical connection with the departments to which they belong, and an investigation of their origin is necessary in order to find out how they became attached to the several departments. It usually came about in this way. Some government official became deeply interested in a certain line of scientific work bearing upon the development of the country. After agitating the matter for several years he finally secured an appropriation from Congress authorizing the investigation to be made in the de-

partment with which he was connected. Either the originator or some other friend of the scheme was put in charge of the work, and if it proved beneficial it received increased appropriations from year to year, and finally grew to be a great bureau. This method has led to some strange connections. It was in this way that the Coast Survey, the Commissioner of Navigation, the Marine Hospital Service and the Life Saving Service came to be placed under the Treasury Department, while the Navy Department controls the National Observatory, the Hydrographic Office and the Nautical Almanac. These accidental connections, once established, have usually been kept up, and so far, although they are often as disadvantageous as they are illogical, a majority of the bureaus have remained in the departments where they originated.

The time has arrived when the successful prosecution of the scientific work of the government requires that these various bureaus should be organized in accordance with a logical plan. A general coordination of all such investigations must be the next step in their development. It is proposed in this paper to suggest a plan which, it is believed, will, without injuring the work of any of them, lead to a reorganization of these bureaus and effect the necessary coordination of their researches.

The scientific agencies connected with the execution of the laws, with the construction of naval and military equipment, and with the government schools, are, of course, not included in this plan. A chemical laboratory will, for example, probably always be needed in connection with the revenue office of the Treasury Department, for the purpose of analyzing sugars, alcoholic liquors, etc. The War and Navy Departments will always need their own testing laboratories, and both the naval and military academies their extensive teaching equipments. The present discussion applies only to those agencies of the government which are designed to promote pure science or its applications to the discovery, conservation and development of the resources of the country in the broadest sense of these terms.

A rational classification of these government scientific agencies would begin with the National Observatory and the Nautical Almanac, which locate our planet in space and our country upon the globe, and supply our mariners with the data by which to sail. Next would come the Coast and Geodetic Survey, which determines the coast and boundary lines of the country and its chief heights and geographical positions. Following this would come the Geological Survey, which is charged with 'the classification of the public lands and the examination of the geological structure and resources of the national domain.' The Weather Bureau, whose duty it is to investigate our climate, and especially its relations to agriculture and other industries, would naturally come next. This would be followed by various agencies for studying the fauna and flora and determining the life zones, such as the Biological Survey, the Divisions of Entomology and of Botany, and the National Museum, including the National Herbarium.

The great economic applications of the principles elucidated by these surveys would be carried out by another group of bureaus, like the Forestry Bureau, the Agricultural and Horticultural Bureaus, and the Fish Commission. These, in turn, would be followed by other agencies organized for the purpose of investigating great economic problems, such as the forage interests of the country, the irrigation question, the industries of the arid region, and so on. Finally, the new department should include a great statistical agency, such as the proposed permanent census bureau. Statistics, showing the products of natural

forces and the results of the people's work along all lines of endeavor, form the basis of all economic science, and would be needed, therefore, in connection with the work of the bureaus above mentioned. Many of them would have to assist in collecting these data. There must, therefore, be the most intimate cooperation between the agencies of the government for the exploitation of resources and the promotion of industries, and the census bureau which measures the one and counts the results of the other.

The list appended to this paper includes the chief government scientific agencies having these, or similar objects, as distinguished from the purely executive agencies of the government. It shows that the United States government now employs 5,225 persons in this scientific and economic work, not including the census, and expends for it annually nearly eight million dollars.

A glance at this magnificent array of forces is all that is necessary to impress one, not merely with the grand initiative of the American people which has called them forth, but with their sadly divided and scattered condition; for the appended list also shows that our government is now supporting twenty-eight separate scientific bureaus, surveys, divisions or investigations, distributed among six different departments, not including fifty-four agricultural experiment stations and many other outlying agencies. Science is conducting in America a grand campaign for the advancement of civilization, but its forces are divided into so many camps that it does not win half the victories it should. What we want is an organized army, with a general staff and a commander-in-chief.

DUPLICATION OF WORK.

Scattered, as our scientific agencies are, through all the departments, organized under broad and often very indefinite laws, supervised and directed, when they receive any attention at all, by different Secretaries, usually not scientific men and always overrun with other work, there is ample opportunity for confusion and duplication of work, and consequent waste of time and money. A few illustrations will show how this works.

The government has three separate and distinct agencies for measuring the land of the country: namely, the General Land Office and the Geological Survey, both in the Interior Department, and the Coast and Geodetic Survey, in the Treasury Department. In addition to these, the Engineer Corps of the Army makes military, boundary and geographic explorations and surveys.

There are four hydrographic offices in as many departments, viz, the Hydrographic Office of the Navy, a similar office in the Coast Survey of the Treasury Department, the Division of Hydrography in the Geological Survey (Interior Department), which measures the rivers of the arid regions, and the Weather Bureau, which measures rivers and studies lake currents. These agencies are supposed to have different fields of labor, but all are liable to meet in the navigable rivers of the country.

In addition, the Fish Commission measures the waters of fishing grounds and rivers, the Engineer Corps of the Army measures the Mississippi River, the lakes and harbors. Four or five of these agencies have actually been engaged in making measurements and studies in the navigable rivers and the Great Lakes within the last few years.

The Coast Survey, the Naval Observatory and the Weather Bureau have all been engaged in recent years in studying the magnetism of the earth.

The government has at least five separate and distinct chemical laboratories in the city of Washington alone.

There are many other scientific agencies similar to those in Washington scattered throughout the country in mints, government schools, hospitals, etc., which receive appropriations for general work.

The Secretary of the Interior and the Secretary of Agriculture some time ago appointed a board to compile the laws on irrigation, and find out what each bureau of each department should do. It took this board a year to inform these two Secretaries what the law required of each of them. Its report shows that eight bureaus in the two departments must cooperate in order to accomplish any thorough work on the great problems of irrigation. Three distinct branches of the Interior Department alone are engaged in irrigation work, viz, the General Land Office, the Office of Indian Affairs and the Geological Survey. The last Census also prepared a report on this subject. The Weather Bureau and the Divisions of Soils and Vegetable Physiology of the Department of Agriculture should assist in these irrigation investigations. It is needless to say that, with so many agencies to promote irrigation, very little has been done by any of them. The Hydrographic Division of the Geological Survey deserves the credit of having done most of what has been accomplished.

Although the agricultural experiment stations receive an annual appropriation of $720,000 through the Department of Agriculture, which has an Office of Experiment Stations for compiling the results of their work, advising and assisting them, the management of their affairs is vested entirely in independent State Boards, and the supervision of the Department of Agriculture is limited at present to the reports of expenditures submitted by the station officers. Their plans of work are usually formulated by local boards or executive committees, and cover nearly all conceivable subjects connected with agriculture, horticulture and the animal industry. Only a few feeble efforts have so far been made to correlate and coordinate the investigations of these stations for the purpose of preventing duplication.

The statistics of the natural resources and the products of the country, of exports and imports, of population, schools, etc., are, in like unfortunate manner, collected and compiled by eight or ten different agencies in five or six different Departments. Besides the Census, which has collected and discussed nearly all conceivable classes of statistics, we have these agencies regularly at work: Meteorological statistics are collected by the Weather Bureau; statistics of 'mineral resources and natural products of the national domain' by the Geological Survey; agricultural statistics are collected by the Department of Agriculture; statistics of exports, imports, etc., by the Treasury Department; statistics of wages, cost of living, and industrial statistics of all kinds, are collected by the Department of Labor; statistics of transportation are collected by the Interstate Commerce Commission; statistics of fisheries are collected by the Fish Commission; and statistics of schools, colleges and universities are collected by the Bureau of Education in the Interior Department.

The same confusion exists in the practice pertaining to other lines of work. Illustrations might be almost indefinitely multiplied. But the reader must be referred to the appended list and the reports.

This duplication is the necessary result of the lack of efficient organization. Bureaus for doing the same or closely related things have been attached to many of the Departments and have remained there. Congress has been liberal to them, and they have extended their work until many of them now overlap each other. This overlapping of work is not so bad, however, as the almost total absence of cooperation.

Since the different bureaus are under different Secretaries, there is no way to enforce cooperation.

THE REMEDY.

What is needed is a general coordination of the scientific work of the government. The question is how to accomplish this. It is probable that a commission of Congress or of scientific men, while perhaps not able to reconcile all the conflicting interests involved in a general plan of reorganization, would still be productive of much good. But the first thing is for Congress to decide upon a program.

An important step was taken when the officers and employees of the scientific bureaus were put in the classified service. This renders it almost impossible to use patronage in getting appropriations or promoting legislation, and puts every man on his mettle to maintain his place by good work instead of political influence, which signifies a great deal. It is not believed, however, that much further progress can be made toward the reorganization of these bureaus and the coordination of their work until they have first been brought together under one executive head. However good their intentions and earnest their desires to do so, it is not likely that the several heads of Departments can ever agree as to the plans of scientific work which shall eliminate all duplication. Each would consult his chiefs of bureaus and be influenced by their advice, and naturally each chief will want to retain his hold upon all his former work. It is evident, therefore, that the only way to avoid duplication and waste of time and money, and to secure the proper coordination and cooperation, is to first bring all these bureaus together in one of the existing departments or in a new department.

When these bureaus have been thus brought together under the direction of one Secretary or executive head, the reorganization will be comparatively easy. It should take place naturally and gradually in the course of ordinary business. The details of this reorganization can not be considered until the new department has been formed. When this has been done the plans for the reorganization might well be left to a board composed of our leading scientific men or of the chiefs of the bureaus involved, presided over by the Secretary or some eminent scientist, appointed by him, who would act as arbitrator.

No revolutionary proceedings are advocated. The policy should be to transfer the different scientific bureaus or surveys to one department, as opportunity offers, or as the Secretaries now having charge of them find it expedient to recommend it. Let Congress once adopt a fixed policy with regard to this matter and establish it in the good opinion of the people of the country, and the rest would follow in good time. A great new department of science would thus be the result of natural development rather than of revolution, and the reorganization and coordination of the work would in the end be accomplished without injury to any scientific investigations now in progress.

It is really a wonder that our government has accomplished so much excellent scientific work through the agency of so unscientific an organization. With enormous expenditure of brain and money, it has done a vast deal for the advancement of science, but it is deplorable that so much has been wasted in doing this. We garner the golden grain of truth, to be sure, but we cut our wheat with the old-fashioned sickle, bind it with straw, thresh it with the flail, and then wait for a favorable wind to blow away the chaff. Harvested by these antiquated methods, our product costs us a great deal more than it should, and, what is worse, we lose

a large part of the grain. Shall our government not use the most improved machinery for its work? Is it not time that we had a complete scientific department for harvesting scientific truth? Such a perfect machine would garner—and garner at much less cost—a far larger harvest than the varied cumbrous appliances now in use.

Chas. W. Dabney, Jr.

A LIST OF THE SCIENTIFIC AGENCIES OF THE UNITED STATES GOVERNMENT, ENGAGED EITHER IN THE PROMOTION OF PURE SCIENCE OR IN THE DISCOVERY AND DEVELOPMENT OF THE RESOURCES OF THE COUNTRY.

They are arrranged under the Departments with which they are at present connected. Only their chief duties, compiled from the statutes and reports, are enumerated. The amounts of money appropriated for their expenses for the fiscal year ending June 30, 1897, and the total number of employees connected with each, are added.

IN THE NAVY DEPARTMENT.

Naval Observatory: The National Observatory: Makes astronomical observations, corrects chronometers, etc. Appropriation, $51,660.

Total number of employees, 48.

Nautical Almanac: Prepares the American Ephemeris and Nautical Almanac, collects and disseminates information on navigation. Appropriation, $22,480.

Total number of employees, 20. Does not include detailed officers.

Hydrographic Office: Collects information and publishes charts with regard to direction and force of winds; set and strength of currents; feeding grounds of whales and seals; regions of storm, fogs and ice; the position of derelicts and floating obstructions; the best routes to be followed by steam and sail; also general hydrographic and marine meteorological information, weather warnings, etc. Appropriation, $103,940.

Total number of employees, 79, exclusive of those in twelve branch offices.

IN THE TREASURY DEPARTMENT.

The Coast and Geodetic Survey: General location of the National domain; latitudes and longitudes; surveys of coasts, rivers, lakes, inland waters, and deep seas adjacent to our coasts; magnetic and gravity research; general survey of the country; heights, geographical positions, etc., $401,370.

Total number of employees, 163.

The War Department also surveys military reservations, and runs boundary lines, such as the boundary line between the United States and Mexico, when called upon to do so.

IN THE INTERIOR DEPARTMENT.

The General Land Office: Is charged with the survey, sale and general management of the public lands and the issuing of titles therefor. It classifies mineral and swamp lands, protects the public domain from depredations, etc. Appropriation, $1,651,940.

Total number of employees: In Washington, 380; outside Washington, 789—1169.

The Geological Survey: By the original act this survey is charged with 'the classification of the public lands and the examination of the geological structure, mineral resources and products of the national domain.' This was first considered as limiting its work to the Territories, but in 1882 authority was granted to continue the work upon the geological map of the United States. Under this law the words 'national domain' are construed as including the entire country, and the provision for studying the 'products of the national domain' is understood to give the Geological Survey broad authority for many kinds of scientific work. At the present time the Survey is engaged on no work not specifically provided for by statute.

As at present organized, the Geological Survey has, beside two administrative branches, two scientific branches, viz, a geologic branch and a topographic branch.

The operations of the geologic branch include the preparation of a geologic atlas of the entire United States, and special geologic researches. The paleontologic work is subsidiary to the geologic work, and is conducted by a division under this branch. The other divisions of this branch are: A chemical laboratory, which analyzes minerals and ores; a lithologic laboratory, in which thin sections of rock are prepared for study; a division of mineral resources, which collects and compiles mineral statistics, and a division of hydrography, which studies the underground and surface water supplies of the country with special reference to applications thereof in irrigation.

The topographic branch has a division of triangulation and a division of topography, the latter divided into five sections.

Total appropriation for the Geological Survey, $774,862.38.

Total number of employees: 335 permanent, 265 temporary field men—600.

The Geological Survey, in addition to the above, is now engaged in making, under special enactment, a land sub-division survey in the Indian Territory.

Bureau of Education: Collects facts and statistics showing the condition and progress of education in the States and Territories and supplies information respecting the organization and management of schools, school systems and methods of teaching; promotes education. Appropriation, $57,520.

Total number of employees, 44.

The Decennial Census: Collects statistics covering population, mortality, manufacturing, railroad, fishing, mining and other industries; statistics of telegraph, express and insurance companies, and of churches; and other subjects according as Congress directs in the special law for each Census. These laws are usually drawn to include every reasonable suggestion that is made to the Committee on the Census, and vary more or less for each Census.

The result is that the Census is made to duplicate, to a large extent, the work of the permanent bureaus of the government. It is supplied with large sums of money, and reports are often made by it which ought, in the nature of things, to be made by other government bureaus. This leads to further duplication and great waste of time and money. Much work is expended upon ill-advised or poorly organized schemes.

The Permanent Census now proposed will consolidate much of this scattered work and prevent duplication almost entirely. It should take charge of several other statistical agencies and do, on a systematic plan through ten years, the work hitherto done in a haphazard way at intervals. It is a move in the same direction as that here advocated for the other scientific bureaus.

The average expense of the Census alone, not including the existing bureaus mentioned herein under their own Departments, is estimated at, $1,000,000 per annum.

THE DEPARTMENT OF AGRICULTURE.

This Department is wholly devoted to the development of the natural resources of the country. It is not restricted to agriculture, but aims to promote all of our industries, for which reason it might be better named 'The Department of Public Works.'

Its organization is as follows: The administrative and business officers are: Secretary's Office; Division of Accounts and Disbursements; Division of Publications with a Document Section; Gardens and Grounds; Seed Division.

Its scientific and technical agencies are:

Weather Bureau: Has charge of the forecasting of weather; the issuing of storm and other weather signals; the gauging of rivers; the reporting of temperature and rainfall conditions for the cotton, rice, sugar and other interests; the taking of meteorological observations to establish and record the climatic conditions of the United States, and the distribution of meteorological information. It includes: Five investigators, meteorological data division, forecast division, climate and crop service, instrument laboratory, monthly weather review and has one hundred and fifty-four weather observing stations, etc.

Bureau of Animal Industry: Inspects meat for interstate and export trade; is charged with the control and eradication of contagious diseases, and the inspection of imported and exported animals; investigates diseases of animals; prepares tuberculin and mallein for distribution to the States; studies animal parasites of domesticated animals, etc.; collects and distributes information in regard to the dairy industry, etc. It includes: Division of animal pathology, zoological laboratory, biochemic laboratory, inspection division, field investigations, dairy division, experiment station, and has, in addition, one hundred meat inspecting stations in the country; twenty-one quarantine stations on coast, Canadian and Mexican borders; nine stations for inspecting exported stock; nineteen Texas fever inspection places, etc.

Division of Statistics: Collects information as to the principal crop and farm animals; collects and coordinates statistics of agricultural production, distribution and consumption; publishes a monthly crop report for the information of producers and consumers and for their protection against combination. It supervises twenty outside statistical agents and has a section of foreign markets.

Biological Survey: Studies the geographic distribution of animals and plants; maps the natural life zones of the country; investigates the economic relations of birds and mammals, and promotes the preservation of beneficial and the destruction of injurious species.

Division of Botany: Maintains the National Herbarium (under the Smithsonian!), publishes information on the treatment of weeds, experiments with poisonous and medicinal plants, and tests seeds with a view to their increased purity and commercial value.

Division of Forestry: Experiments, investigates and reports upon the subject of forestry, and disseminates information upon forestry matters.

Division of Agrostology: Investigates the natural

history, geographical distribution and uses of grasses and forage plants, their adaptation to special soils and climates, and the introduction of promising native and foreign kinds.

Division of Vegetable Pathology and Physiology: Seeks, by investigations in the field and experiments in the laboratory, to determine the causes of disease and the best means of preventing them; studies plant physiology in its bearing on pathology.

Division of Entomology: Obtains and disseminates information regarding insects in their relation to vegetation; investigates insects sent to the division in order to give appropriate remedies; studies insect life in relation to agriculture in different parts of the country; conducts an insectary for studying the habits of insects, etc.

Division of Pomology: Collects and distributes information in regard to the fruit interests of the United States; investigates the habits and peculiar qualities of fruits; their adaptability to various soils and climates and conditions of culture, and introduces new and untried varieties.

Division of Chemistry: Investigates the methods proposed for the analyses of soils and fertilizers, and agricultural products; investigates and reports on adulteration of foods and on special subjects as ordered by Congress or the Secretary, conducts chemical investigations for other bureaus of the Department of Agriculture.

Division of Agricultural Soils: Investigates the texture and other physical properties of soils and their relations to crop production.

Office of Experiment Stations: Represents the Department in its relations to the experiment stations in all the States and Territories, for which the government appropriates $750,000 annually; collects and disseminates general information regarding the colleges and stations; publishes accounts of agricultural investigations at home and abroad; indicates lines of inquiry; aids in arranging for cooperative experiments; reports upon the expenditures and work of the stations.

Office of Fiber Investigations: Collects and disseminates information regarding the cultivation of textile plants, including new and hitherto unused kinds; investigates the merits of new machines and processes for preparing them for manufacture.

Office of Road Inquiry: Collects and distributes information concerning the systems of road management in the United States and the best methods of road-making.

The total appropriation for the Department of Agriculture is $2,448,532.

Total number of employees, 2,043.

Agricultural Experiment Stations: In addition to the above the government appropriates annually, for 54 Agricultural Experiment Stations in the States and Territories, $720,000.

Total number of employees in stations, 575.

The work of this Department is very closely related to that of the others. That of the Division of Soils, for example, depends upon the work of the Geological Survey. The work of the Weather Bureau is also very closely associated with that of the Hydrographic Office of the Navy and of the Coast Survey. These various Departments, Bureaus, and Divisions overlap and cross each other everywhere, causing many duplications and difficulties.

UNDER THE SMITHSONIAN INSTITUTION.

Bureau of Ethnology: Collects, compiles and publishes information with regard to the native races of America. Appropriation $45,000.

Total number of employees, 21.

U. S. National Museum: "The authorized place of deposit for all objects of art, archæology, ethnology, natural history, mineralogy, geology, etc., belonging to the United States or collected by any agency whatsoever for the government of the United States, when no longer needed for investigations in progress. The collections in the Museum are intended to exhibit the natural and industrial resources, primarily of the United States and secondarily of other parts of the world, for purposes of comparison."

Total appropriation, $187,725.

Total number of persons employed, 197.

COMMISSION OF FISH AND FISHERIES.

Formerly connected with the Smithsonian Institution. Not now connected with any department. Studies the rivers, lakes, bays and fishing grounds along the coast for the purpose of determining their food resources and of promoting the development of the commercial fisheries; collects and compiles statistics of fisheries; propagates and distributes fish and conducts laboratories for studying marine life, etc. Total appropriation $347,360.

Total number of employees, 172.

DEPARTMENT OF LABOR.

Not connected with any of the Executive Departments. Collects and publishes useful information on subjects connected with labor; its relations to capital; hours of labor; earnings of laboring men and women; means of promoting all their interests; investigates strikes and controversies between labor and capital; cost of production in competing countries, including wages, etc. Total appropriation $172,170.

Total number of employees, 94.

There are many other minor agencies scattered through the Departments which contribute much to the development of the country's resources.

The total appropriations for 1897 to the Departments and Bureaus above described as engaged in promoting science and the development of the country amount to $7,984,559.38.

The total number of employees in the above Departments and Bureaus is, not including the Census, 5,225.

GEOLOGICAL SOCIETY OF AMERICA: NINTH ANNUAL MEETING, WASHINGTON, DECEMBER 29–31, 1896.

THE Geological Society of America was called to order for its ninth annual meeting in the lecture room of the National Museum at 10 a. m., December 29th; President Joseph LeConte, of Berkeley, Cal., in the chair. An address of welcome was delivered by Mr. Charles D. Walcott, Director of the United States Geological Survey, to which a response was given by President LeConte. The local reception committee, through its chairman, Mr. S. F. Emmons, stated the arrangements that had been made for the entertainment of the Society, which included a daily lunch in the museum, a trip through the new Congressional Library with Capt. Green, the Superintendent, and the privileges of the Cosmos club to the fellows and their friends.

The Council presented its printed report, which was laid on the table for one day. Messrs. Hague and Kemp were appointed a committee to audit the accounts of the the Treasurer. The result of the election of officers for the ensuing year was then announced as follows: President, Edward Orton; First Vice-President, J. J. Stevenson; Second Vice-President, B. K. Emerson; Secretary, H. L. Fairchild; Treasurer, I. C. White; Editor, J. Stanley-Brown; Councilors, J. S. Diller, W. B. Scott.

The following fellows were also elected: Rufus Mather Bagg, Assistant in Geology at Johns Hopkins University and on the Maryland Geological Survey; Erwin Hinkley Barbour, Professor of Geology in the University of Nebraska; Samuel Walker Beyer, Assistant Professor of Geology, Iowa Agricultural College, Ames, Ia.; Arthur P. Coleman, Professor of Geology, Toronto University; Henry Stewart Gane, Assistant Geologist, U. S. Geological Survey; John Bonsall Porter, Professor of Mining, McGill University, Montreal; Arthur Coe Spencer, Assistant Geologist, U. S. Geological Survey.

A memorial of Robert Hay was then read by R. T. Hill, and one of Charles Wachsmuth, written by Samuel Calvin, was read by J. Stanley-Brown. A memorial of N. J. Giroux was postponed until the following meeting, as the manuscript was not at the moment available.

The reading of papers was then immediately taken up.

Crater Lake. J. S. DILLER, Washington, D. C.

Crater Lake is deeply set in the summit of the Cascade Range, of Southern Oregon. It is remarkable for its beauty and depth, the grandeur of its encircling cliffs and its geological history. During the glacial period the site of the lake was occupied by a huge volcano comparable in size with Shasta or Rainier. Since then the upper third has disappeared and a pit has formed in its base 4,000 feet deep. The pit is half filled with water forming Crater Lake. The paper was illustrated by lantern slides, and in the course of its presentation the crater lakes of Europe were briefly reviewed and compared with the one in Oregon. The lava flows were described and the peculiar radiating and glaciated valleys that pass out from the cone downwards, but that end in the air upwards. All the phenomena indicated a sinking in, absorption and withdrawal of the cone, leaving the present depression. In discussion President Le

Conte described his own visit to the lake in earlier years with Capt. Dutton, and H. F. Reid inquired as to the amount of erosion visible in the cliffs surrounding the water, to which Mr. Diller replied that there were no beaches to indicate it. On this line Prof. Shaler remarked the great increase in size that had been brought about in the Italian lakes by wave action and the need of caution in estimating the amount of rock that had been engulfed. He also cited the complex character of certain of the Italian ones. Mr. Diller replied that Crater Lake was a unit and gave reasons for thinking that it had not been much enlarged. Mr. Turner cited the vast tuff deposits of the Sierras, which he attributed to mud-flows of tuffs on a grand scale and suggested the applicability of the idea to some of the earlier phenomena in the history of Crater Lake.

The Leucite Hills, Wyoming. J. F. Kemp, New York, N. Y.

After a brief review of the occurrence of leucite the world over and especially in North America, the lantern was used to show the geographical situation and distribution of the Leucite Hills. Three of the outcrops, viz: the Leucite Hills proper, Orenda Butte and Black Rock Butte were described with photographs. Photomicrographs were next used to illustrate the rocks. It was shown that while leucite was as rich in some parts of the southern mesa as described by Zirkel, yet in other places and in the buttes to the north it became more rare and sanidine came in in much greater amount. Hauyne, large augite phenocrysts with rims of biotite and inclusions of limestone and sandstone, were also described. Zirkel's description was quoted in extenso and corroborated for the portions of the flows visited by the geologist of the Fortieth Parallel Survey, but the fuller field work has indicated considerable variability. The cones which look like craters were shown to be solid and were explained as portions which were viscous when intruded so that they remained over the old vents. Pilot Butte, north of Rock Springs, was also described, and the rock was shown to consist of augites and biotite in an isotropic base, regarded as glass. The determination of it as trachyte in Volume II. of the Fortieth Parallel Survey was therefore questioned.

Mr. Cross in discussion spoke of his own visit to the Hills twelve years before, and of the general parallelism of his observations with those of the speaker. Mr. Kemp expressed the hope that Mr. Cross would publish his observations and analyses at the earliest convenient date.

The Solution of Quartz under Atmospheric Conditions. C. Willard Hayes, Washington, D. C.

The projecting portions of quartz pebbles in conglomerates at a number of localities in the South have been found deeply etched, and chalcedonic quartz nodules partially dissolved. The chemical conditions under which the solution may have been effected were considered, and the bearing of the facts observed on the problems of erosion briefly pointed out. The latter point was more fully discussed in Mr. Campbell's paper on 'Erosion at Baselevel,' which followed. Mr. Hayes described the solution of the silica as occurring in a region of heavy forest where fires are frequent. In this way both organic acids and alkaline salts are afforded which effect the solution. Specimens were passed around in illustration which were very significant. Mr. Kemp, in discussion, called attention to the parallel conclusions reached by Dr. A. A. Julien in his study of the talus of the Palisades some years before. Mr. Gilbert cited the recent cementation of sands with silica in the arid regions of the West, and remarked the varying be-

havior of different forms of silica under solvents, some being easily attacked, others very resistant. Prof. Shaler raised the point that it was a reaction taking place on or near the surface and not in depth. Prof. Emerson described his observations on the schists and traps of the Connecticut Valley, where quartz and silicates on the surface were resistant, but where exposed in crevices to the drip of mosses and lichens they were deeply affected. Prof. Stevenson cited the sandstones of central Pennsylvania, where some were greatly corroded on the outcrops, whereas others, such as the White Medina, were very smooth. I. C. White corroborated the last speaker, and cited the change of flint to chalcedony in the lower Carboniferous limestones. M. R. Campbell described the smooth character of the Medina in Virginia at the surface, but its pitting under cliffs where exposed to dripping water. As the following paper was on the same general subject, practically the same discussion continued in connection with it.

Erosion at Baselevel. MARIUS R. CAMPBELL, Washington, D. C.

Many local baselevel plains in the Appalachian coal field show a sharp line of demarcation between the level floor of the basin and the surrounding slopes. Since the streams are too sluggish to mechanically transport the waste of the land, this condition can be explained only by supposing that most, if not all, of the material which is swept in from the surrounding slopes is removed by solution when it reaches the floor of the basin.

Etched quartz pebbles and geodes are evidence that under favorable conditions silica may be dissolved; therefore it remains to determine whether such conditions are liable to be present on a baselevel plain. The solution of the quartz appears to take place only in the presence of decaying vegetation, consequently the swampy character of such a plain would offer almost ideal conditions for the removal of the silica as fast as it is washed in from the surrounding slopes. The alumina is still unaccounted for, but the question was raised that some similar reaction may take place, which removes this compound also.

Mr. Turner, in discussion, emphasized the preeminent insolubility of the quartz that forms the veins of the Sierras, as shown by its occurrence in the prevailing boulders of the local conglomerates. He stated that the pitting of chalcedony may be due to the solution and removal of limestone. Mr. Keith also supported the insolubility of the quartz and cited the baselevel superficial soils and gravels near Washington. The residual pebbles are derived from the quartz veins, whereas the other minerals of the gneisses are only represented by a red clay. Mr. Hayes, in support of Mr. Campbell's position, mentioned the ponds in the plateau of the Coal Measures of the South, which plateau is deeply dissected by streams. He stated that much silica might be removed and yet no pitting result to indicate it. Dr. Wadsworth mentioned his own observations on the Potsdam and St. Peter's sandstones of Wisconsin, made many years ago. An outer shell of hardened rock forms by redeposition of silica, and may even be appreciable within a year's time. He also mentioned the well recognized removal of silica in the formation of the soft hematites of Lake Superior, and emphasized its ready and great solubility under favorable conditions. Professor LeConte laid stress on the solubility of different forms of silica, and Mr. Hayes, in closing the discussion, admitted freely the frequent insolubility of quartz, but still urged the significance of the observations of Mr. Campbell and himself, which, indeed, were unassailable.

The Origin of Certain Topographic Forms. MARIUS R. CAMPBELL, Washington, D. C.

This paper consisted of a study of the various conditions affecting erosion for the purpose of determining the origin of certain exceptional surface features which have not hitherto been satisfactorily explained. The writer reaches the conclusion that local radial movements of the crust of the earth are largely responsible for the exceptional physiographic features.

This theory was then applied to the North Carolina section of the Blue Ridge, and it was shown that the striking features of that region can be explained by supposing a monoclinal uplift to have occurred along the eastern front of the Ridge while the main body of the Piedmont plain remained at sea level. On this assumption the various remnants of peneplains in the Blue Ridge region correspond to halts in the general uplift, and they collectively represent the same, or a portion of the same time interval which is marked by the Piedmont plain to the eastward of the uplift.

Since local uplifts are liable to occur at any time and in any place, the resulting forms may be found in other localities than the Appalachians, and physiographers should learn to distinguish them, for they constitute a record of exceptional conditions.

The paper was illustrated by a large map which brought out the position of the Appalachians south of Roanoke, Va., to which the hypothesis especially applied, but the region of the Black Hills was also cited as a promising place in which to test it.

Mr. Keith, in discussion, spoke in opposition to Mr. Campbell's view and sketched a district on the Nahantahala and Hiwassee rivers in support of his contention. It was later shown that the district, however, was not in the region described by Mr. Campbell and had but limited bearings on his thesis.

Homology of Joints and Artificial Fractures. J. B. Woodworth, Cambridge, Mass.

A synopsis of the structure of the typical joint was given from a previous paper (Proc. Boston Soc. Nat. Hist., Vol. XXXIV, 1896, pp. 163–183). A series of specimens showing the relations between joints and artificially fractured surfaces was exhibited. Obliquity of the biplanes in the margin of fractures is found of value in determining the axis of breaking tension arising from tension, contraction or shearing force. Incidentally, a map symbol for joints was proposed.

The paper was illustrated by an excellent and striking series of lantern slides which made the matter clear.

Physiographic Development of the District of Columbia Region. N. H. Darton, Washington, D. C.

An outline of the physiographic conditions which have characterized each of the earlier stages in the Coastal Plain history of the region and a description of the development of the present topography was presented in a very interesting manner. By means of lantern slides from maps and photographs, the ups and downs of the old shore-lines were shown and the formation of the terraces. In this way the development of the Potomac, Magothy, Severn, Chesapeake, Lafayette and lower and upper Columbia formations were traced.

Dikes in Appalachian Virginia. N. H. Darton, Washington, D. C.

An announcement of further discoveries of diabase dikes and of interesting dikes of acidic eruptives among the Paleozoic rocks of central Appalachian Virginia. When the specimens were passed around, the acidic intrusions, containing, as they did, quartz, feldspar, mica and hornblende phenocrysts in a white ground mass, excited extreme interest, and, as remarked by J. E. Wolff, were very similar to the quartz-mica-porphyrite in the Cortlandt series, near Montrose, N. Y.

On the Changes of Drainage in the Ohio River Basin. FRANK LEVERETT, Denmark, Iowa.

A brief outline of the results of earlier observations on the Ohio and tributaries was followed by a presentation of the results of the writer's studies the past season. The principal topics discussed were as follows: 1. The extent and probable date of deposition of marine deposits found on the lower Ohio, in Indiana, Kentucky and Illinois. 2. Comparison of the probable early drainage systems with the present system. 3. Factors leading to changes of drainage. 4. An interpretation of the relative influence of the several factors in producing the changes of drainage which have occurred in the Ohio River basin. In developing this general plan the writer described, by means of a map, the present drainage systems of western Pennsylvania and their probable discharge, through northerly outlets, now indicated by present streams, into Lake Erie. The former limit of the northerly drainage was probably along the Panhandle of West Virginia. The old drainage lines were detected by following up the remnants of the fluvial plains. Of the three possible causes of change in drainage systems, viz, uplift, stream piracy and glaciation, the last named was regarded as most probable. Prof. G. F. Wright opened the discussion by objecting to some of the proposed northerly outlets as of insufficient size to carry the volume of water. H. P. Cushing later on supported this objection strongly in the case of the Cuyahoga river. Mr. Leverett replied that the gorge was as large as that of the present Ohio below Louisville. M. R. Campbell endeavored, by means of the changes suggested by Mr. Leverett, to account for the puzzling phenomenon of Teazes Valley and its boulders from the New River Basin; but I. C. White, who originally discovered and described Teazes Valley, stated that it could be satisfactorily explained by the Mud and Guyandotte rivers, which now partially traverse it. Prof. Orton remarked the depth of the drift in northwestern Ohio, and the debt that geology owed to the drillers who had shown many buried channels in prospecting for oil. The depth is over 500 feet in some channels. The peculiar relations of the Mercer reservoir and the difficulty of explaining it were also touched on. Prof. Shaler emphasized the stability and lack of change in the drainage lines of Kentucky and his disbelief that ice had ever crossed the Ohio river, on the ground that water would satisfactorily explain the observed phenomena in Kentucky.

The Society then adjourned until the following day at 10 a. m. The fellows were very generally entertained by the resident geologists of Washington during the early evening, and at 8:30 reassembled in the large hall of the Columbian University to listen to the Presidential address of the retiring President, Prof. Le Conte, upon the title, 'The Different Kinds of Earth Crust Movements and Their Causes.'

DECEMBER 30, 1896.

The Council met at 9 a. m., and the Society at 10. The report of the Council as previously printed and distributed was adopted. A memorial of N. J. Giroux, written by Mr. R. W. Ells, was read by Prof. F. D. Adams. The photograph committee then reported through its chairman, Mr. G. P. Merrill. 179 views were received during the year, bringing the total up to 1429. The auditing committee reported favorably regarding the Treasurer's accounts. The Secretary announced that the Council recommended a change in the constitution so as to add the Editor to the Council, and some other verbal changes, all of which will be acted on one year hence. The reading of papers was then resumed.

Notes on the Structure of the Cranberry District in North Carolina. Arthur Keith, Washington, D. C.

The paper opened with a sketch of the topography, drainage and geology of the district. The latter involves seven members below the Siluro-Cambrian limestones. They are in general schists and gneisses and Pre-Cambrian volcanics. A sketch map was used to illustrate the faults of the region. Great folds also intervene. Faults occasionally show breccias and slickensides, but these are not marked. Pressure has caused metamorphism and schistosity. Remarkable cases of sheared conglomerates of quartz porphyry and granite pebbles were exhibited. The phenomena gave accurate data for determining the depths of zones of crushing and flowage. A great shear zone in an east and west line, with a passage of the southern part beyond the northern, was described. The curious behavior of sediments regarding the hard crystallines, and their strange relations to them, if we assume a simple case of compressive stress, transmitted by the sediments, leads the author to believe in the upthrust of the crystallines through and over the sediments.

Note on the Stratigraphy of Certain Homogenous Rocks. C. H. Hitchcock, Hanover, N. H.

The object of the note was to call attention to recent discoveries of obscure planes of stratification cutting the cleavage at large angles, as noted in two formations in the upper Connecticut Valley. These discoveries will make it necessary to question the reliability of many of the observations hitherto made as to the positions of the strata.

The speaker described an argillite and a quartzite at Thetford, near Hanover, whose true bedding he had been unable to discover until lately. Finally the true stratification was identified in many lines nearly at right angles with the cleavage and as indicated by little quartz veins. Quartzite in another locality was also shown to have suffered so much change that its stratification was obliterated. Various examples were further cited to bring out the relations of cleavage and stratification. In discussion, Mr. Lane asked if the observations of Prof. Hitchcock and Mr. Keith carried out Van Hise's rule that cleavages cutting stratification at right angles indicated the presence of synclines and anticlines. Messrs. Hitchcock and Keith replied that so far as their observations went they did.

Unconformities in Martha's Vineyard and Block Island. J. B. Woodworth, Cambridge, Mass.

Beginning below, plant-bearing beds of Cretaceous age appear in both islands without their base being exposed. On Martha's Vineyard marine Cretaceous strata overlie the plant beds; but contact has not been worked out. Above the Cretaceous and on an eroded surface rests the Miocene of Lyell and Dall, composed of (*a*) the osseous conglomerate, (*b*) the green sand, (*c*) the yellowish green sand. There was erosion in the area between (*a*) and (*b*), probably also between (*b*) and (*c*). Fragments of a Pliocene formation have been detected at Gay Head, but little is known regarding it. A marked unconformity now appears on Gay Head and Block Island at the base of the lowest Pleistocene boulder formation. The Miocene has been locally swept away at Gay Head. On Block Island this early Pleistocene rests upon the surface of the Cretaceous white clays, the Miocene being entirely unknown. There was probably some folding of strata at Gay Head before the deposition of this boulder bed. After the deposition of from 25 to 50 feet of compound gravels and sands, more folding took place over Martha's Vineyard and Block Island. The Mohegan Bluff beds on Block Island and the Tisbury beds on Martha's

Vineyard, of glacial origin, were now laid down on eroded surface of folded older strata. In the Vineyard subepoch of erosion the islands were deeply denuded; then followed the last glacial epoch with deposition of moraines and sand plains.

W. B. Clark, in discussion, called attention to the parallelism of the Cretaceous and Miocene on these islands and in New Jersey and Maryland. David White on paleobotanic evidence of age stated that the plant-bearing clays belonged with the Amboy clays. He also commented on the interest attaching to the subdivision of the Tertiary beds. G. K. Gilbert remarked the complexity of the later Pliocene and glacial deposits, involving, as they do, very coarse and fine components, and coinciding with Chamberlin's observations in the West. David White inquired about the correlation of the beds of the Elizabeth Islands with those of the Vineyard. Mr. Woodworth replied that it could at present be but roughly carried out.

The Cementing Materials of the Tertiary Sands and Gravels of Western Kansas. ERASMUS HAWORTH.

In the absence of the author an abstract was given by G. K. Gilbert, who stated that the cementing material proved to be aragonite with subordinate calcite, and sketched the relation of the deposition of the cement to the conditions of aridity in earlier times.

The Work of the United States Geological Survey in the Sierra Nevada. H. W. TURNER.

The speaker had a series of geological atlas sheets of the work in the Sierras and, using these as illustrations, outlined the large features of the geology.

President LeConte remarked the complexity of the geology of the Sierras. In reply to a question of J. E. Wolff regarding the age of the granodiorites, Mr. Turner replied that they were late Jurassic or early Tertiary and that they exhibited remarkable examples of contact metamorphism on the Jurassic slate. Mr. Walcott remarked the completion of the work on the Gold Belt and the plans for the future work of the Survey in the Sierras.

The Cornell Glacier, Greenland. RALPH S. TARR, Ithaca, N. Y.

The speaker outlined the old view of the continuous ice sheet from Greenland to North America, and the later views of Chamberlin and Salisbury regarding the limited and strictly insular character of it. He described the angular topography of the highlands in the interior, and the more rounded, glaciated slopes terminating in cliffs near the coast, interpreting even the jagged mountains as compatible with glaciation. The location of last summer's work was shown and the Cornell glacier was described. The local rocks are gneiss and schists with diabase dikes. The hills are rounded toward the ice, but are angular toward sea. The ice has covered in recent times Wilcox Peninsula and Duck Islands, showing an extension 30 or 40 miles beyond its present position and from 3,000 to over 7,000 feet thick. The ice is now retreating. Reference points were established from which to measure future movements. All the nunataks have been glaciated, though now bare.

G. F. Wright remarked the parallelism between these observations and his own on the edge of the Arctic circle.

Prof. Heilprin also corroborated the conclusions given about the former larger extent of the ice from his own observations in the region and especially on the Island of Disco. The coast was outlined and the character described from Disco to Robertson Bay. The observations of all these speakers, as well as the important paper of Mr. Barton which followed, flatly controverted the views which have recently been expressed regarding the former extent of the ice and certain of its local phenomena.

Shore-lines of Lake Warren, and of a Lower Water-level, in Western Central New York. H. L. Fairchild, Rochester, N. Y.

The beach of the glacial Lake Warren has been traced with practical continuity from Crittenden, N. Y., where long known, eastward to beyond the meridian of Rochester, with an altitude of about 880 feet. A lower beach, with an altitude of 700 feet and of good development, has been detected for a considerable distance, and other evidences of static water at this level extend over a wide area.

The paper was illustrated by a colored map of New York State showing the outlines of Lakes Warren and Iroquois. The speaker sketched the recent views of Lake Warren's restricted area, and of its outlet into the lake formerly in the basin of Lake Michigan, called Lake Chicago. The tracing of another strong beach above Geneva was also shown, and presumably a continuation of the beach at Chittenden followed. The reading of the next paper took place before discussion.

Old Tracks of Erian Drainage in Western New York. G. K. Gilbert, Washington, D. C.

The last stage of Lake Warren was ended by the shifting of the outlet from Michigan to New York. Between that date and the establishment of the Niagara River the discharge from the Erie basin crossed western New York on lines determined by the relations of the shifting ice margin to the topography.

Attention was called to Lake Warren, which stood 500 feet above Lake Iroquois, and to the areal distribution of both. The spillways were described that were scoured out, when, on the removal of the ice barrier that held back Lake Warren, the water fell to the level of Warren. These old lines of drainage were described with their boulder pavements, cataracts and one-sided channels, formed when the ice presented the other side. The speaker showed these at various points, of which those between Rochester and Niagara Falls are of especial interest. Inference about the east and west alignment of the ice front were also drawn.

G. F. Wright inquired about the relations of the lakes with the Horseheads outlet and later remarked the fresh topography of the spillways. R. S. Tarr also asked about the correlation of the beaches with the Cayuga Lake terraces. Mr. Gilbert replied that Horseheads was at that time higher than the water plane and that he had attempted no correlation with the terraces of Cayuga Lake

The Assumed Glaciation of the Atlas Mountains, Africa. Angelo Heilprin, Philadelphia, Pa.

Vast boulder and pebble deposits cover a large part of the region of North Africa, both at sea-level and on the inland plateaus (and mountain slopes) to 3,000 feet elevation and more. These have in places much the appearance of morainic and true drift material, and as such have been described by some geologists and geographers. But their relations are with oceanic and torrential modelling of the land surface and they give no basis for the supposition that ice action was involved in their making. Neither on the highest points of the Atlas Mountains in Algeria nor on their slopes were any evidences of glaciation met with.

The observations were gathered during a trip across the Atlas Mountains the past summer, through Tunis and Morocco into the Sahara. A resumé was given of previous observations on the supposed glaciation of some of these summits. With a sketch map of northern Africa the speaker remarked the general character of the mountains and their Alpine character. He then described the supposed glacial moraines at

various points and interpreted them as formed by water. No striation, polishing or glacial topography were seen. All seemed due to great accumulations in a westward arm of the Mediterranean that set in from Tunis and ran far up into the mountainous country to the westward.

The Relation of an Abandoned River Channel in Eastern Iowa to the Western Edge of the Illinois Icelobe. FRANK LEVERETT, Denmark, Iowa.

The extension of the Illinois icelobe into southeastern Iowa, discussed by the writer at the Philadelphia meeting, is found to have so blocked the drainage along the Mississippi that the line of discharge was temporarily thrown across the plains of eastern Iowa. The several rivers of eastern Iowa that now lead southeastward into the Mississippi entered this temporary line of drainage and followed it southward. A description of the channel formed by this temporary river was given, and the history of the discovery of its several sections was outlined. Inferences were drawn from it concerning the drainage conditions at the time of the culmination of the Illinois icelobe. The paper was illustrated by a sketch map of Iowa.

F. B. Taylor asked about the channel used by the river during its short cut into its present channel between Cedar river and Iowa river. Mr. Leverett replied that it followed the present channel of the Iowa river. Other remarks regarding the ancient gradients of the river were made by Prof. Reid.

Glacial Observations in the Umanak District, Greenland. GEORGE H. BARTON, Boston, Mass.

The result of studies upon the margin of the inland ice for a distance of about fifteen miles from the nearest land was given. And the character of the surface, of the marginal edges of very steep or vertical slope, of the dust holes area, of the billowy area, and of the smooth, level expanse beyond were described. Ice-walled lakes, with small tributary streams, and large streams were met. Studies upon the Great Karajak glacier, its rate of motion, character of surface and margin, movement phenomena as seen along edge, entrance into waters of fiord, its source in the ice cap with crevasses for miles inland, proved of the greatest interest. Smaller glacial tongues along the Karajak fiord, coming from the local ice cap of the Nugsuak peninsula, were described, together with studies upon the glaciers entering Itivdliarsuk fiord and observations on the former greater extension of the ice cap and the distribution of drift and the transportation of material by icebergs. The paper was graphically illustrated by a beautiful and significant series of lantern slides. C. H. Hitchcock asked about marine deposits, such as Champlain clays. Mr. Barton replied that none were met. As Mr. Barton had stated that the survey of the party had indicated a slight movement of the ice up stream near the shore, and down stream at the outer stakes in the glacier, in each case of but a fraction of a foot, Prof. Reid inquired about the accuracy of the instruments, and cited the need of readings closer than a minute. Mr. Barton replied that they had been made with a high-grade surveying transit, but as that part of the work was directed by a colleague he could not give further particulars. A. Heilprin stated the occurrence of marine deposits with shells in northwest Greenland. Mr. Barton's paper was one of the most interesting and important of the meeting and coincided with the observations of Prof. Tarr further north as earlier cited. The British Admiralty charts, for not using which Prof. Wright has been criticised, were found quite unreliable by Mr. Barton and were rejected in favor of Danish maps.

The Nipissing-Mattawa River, the Outlet of the Nipissing Great Lakes. F. B. Taylor, Fort Wayne, Ind.

When the waters of Lakes Superior, Michigan and Huron were making the Nipissing beach, their outlet was eastward over the Nipissing pass at North Bay, Ontario, to the Ottawa valley. This outlet river is called the Nipissing-Mattawa River and the three upper great lakes of that time are called the Nipissing Great Lakes. During the autumn just passed the course of the outlet river was explored. The Nipissing beach is well developed at North Bay at an altitude of about 700 feet above sea-level. On the swampy col between Lake Nipissing and Trout Lake it was a little over a mile wide with a maximum depth of about thirty feet and an average of from ten to fifteen feet. The beach is faintly but clearly marked to the foot of Trout Lake and the shore mark of the river in expanded portions and at some of its rapids was found at several points below. The best evidence of the existence of the ancient river was found where it crosses the course of a bouldery morainic deposit. The boulders in such rapids were scoured by the sand and pebbles moved along by the current into peculiar forms readily recognized. These rapids were located at moraine crossings. Others were less certainly determined. The place of one cataract was also found. In one of its rapids the ancient river was between 600 and 700 feet wide, with an average depth of 35 to 40 feet. This corresponds very closely, in a general way, with the size of the modern St. Clair and Detroit rivers. The remains of the ancient river agree with the Nipissing beach in indicating that this arrangement of the upper Great Lakes endured for a relatively long period of time.

The paper was preceded by a review of the works of previous observers. In discussion G. F. Wright remarked the interest all must feel in the establishment of this thesis and G. K. Gilbert discussed its relations to Niagara Falls as a chronometer. Increasing knowledge brings increasing complexity.

Moraines of Recession and their Significance in Glacial Theory. F. B. Taylor, Fort Wayne, Ind.

A summary of facts presented last summer at Buffalo was first given regarding moraines between Cincinnati and the Straits of Mackinaw, there being 15 in all, whose differences depend on the topography of the land. The oscillations of the ice front and the moraines is so regular in period that ups and downs of the earth's surface cannot be utilized in explaining them. We are forced to refer to astronomical causes and their effects on climate. Precession of the equinoxes, modified by the revolution of the apsides, was cited as the best cause, with intervals of 21,000 years. This time seems long, but it is corroborated by the large amount of clay in the moraines. The effects of the precessions of the equinoxes were analyzed. The oscillation was corroborated by the relations of the boulder belts in three moraines near Fort Wayne, Ind., to the line of drainage apparently taken by the river that drained the glacier.

In discussion G. K. Gilbert emphasized the interest of the ideas and spoke of them as supplying, if true, the clue for the correlation of the moraines in various regions. Frank Leverett spoke of the importance of the estimates of time and significance of the boulder belts. G. F. Wright remarked that moraines of recession with halts, still implied forward movement of the rear ice continually during halts. Mr. Taylor, in reply to the last speaker, described the moraines as having steep outer slopes and gradual slopes inward, which is only explicable by an advance of ice up to a point and then its accelerated retreat. Mr. Heilprin raised

the point that moraines in existing glaciers are steepest toward the ice and that they were the best illustration of what took place in the ice period. Inferences, therefore, regarding the relations of the old moraines to the ice should always be drawn with this in mind.

Variations of Glaciers. HARRY FIELDING REID, Baltimore, Md.

The paper gave a summary of the first annual report of the International Committee on Glaciers. Information received relating to the variations of American glaciers during the past year, as well as of those in other parts of the world, indicated a general recession, although there were some minor exceptions. Illustrations were given and an earnest appeal was made that all geologists and travelers visiting glaciers establish permanent bench marks and directions from which photographs can be taken, as other visitors may reach such regions. Very complete records can thus be made.

The reading of this paper closed the work of the day. At 7:30 p. m. the Society reassembled for the annual dinner at the Hotel Raleigh. All felt great satisfaction to see Prof. Emerson in his familiar place as toastmaster, and the presence of about fifteen ladies, mostly wives of the Fellows of the Society, started an innovation that it is to be hoped will be continued, for it improves greatly the social side of meetings. The banquet was most enjoyable from all points of view, especially in that the Society had an opportunity to extend its congratulations to the retiring President upon the approaching celebration of his golden wedding anniversary.

On Thursday morning at nine o'clock nearly all the visiting Fellows assembled at the office of Captain Green, at the new Congressional Library, and were most courteously conducted over the building. All viewed its magnificant halls and frescoes almost with astonishment, and certainly with great satisfaction that a building so long needed had at last been worthily constructed.

At 10 a. m. the regular sessions were resumed with a slim attendance, which, however, rapidly grew as the members who had been at the Library returned. It was voted that two sections be organized after the reading of the first two papers, inasmuch as it would be otherwise impossible to finish the programme. A letter was also read from Lieut. Peary outlining a plan for another expedition to Greenland next summer, in which it was hoped that various institutions would combine and locate stations for the observation and study of the ice sheet at various points along the coast and in cooperation. The Society gave its approval of the plan in a general way. The reading of papers was then resumed as follows:

Mechanics of Glaciers—Moraines and Stratification. HARRY FIELDING REID, Baltimore, Md.

Observations were made on the Forno Glacier last summer to test the ideas presented to the Society at the Philadelphia meeting. Measures of the movement were begun but not finished. What is usually called the 'ribboned structure' is probably the outcrop of the strata, as Agassiz contended.

Moraines require a new classification into: 1st, those which have their origin below the névé line; and 2d, those which have there their origin above it. The latter present characteristics which have not hitherto been carefully described. It was shown that the débris above the névé line proceeds diagonally downward into the body of the glacier itself as it becomes buried by the successive annual snowfalls that cause the general stratification. The paper was beautifully illustrated by lantern slides. Presi-

dent LeConte inquired about the relations of the phenomena of the dirt bands described by Agassiz years ago. Mr. Reid stated that he was uncertain exactly what was meant by them, but he believed them to be the same as the lines of stratification and to originate as he had described, by the annual burial of fine débris above the névé line.

The Pre-Cambrian Topography of the Eastern Adirondacks. J. F. Kemp, New York, N. Y.

The discovery of outliers of Paleozoic strata, oftentimes of very small area, far within the Archean (perhaps in part Algonkian) complex of the Adirondacks, has made possible the tracing out of some of the Pre-Cambrian topographical features. The recent completion of the topographical sheets of the U. S. Geological Survey has enabled us to illustrate the matter quite fully and with comparisons of present altitudes. It was shown that the early Paleozoic sea apparently set up into narrow embayments in what were doubtless old submerged valleys, which being now indicated by the outliers, reproduce, in a general way, some features of the old topography. The abundance of Potsdam boulders in the drift far in the hills leads to the conclusion that the Potsdam was probably more abundant in the interior before the ice invasion than now.

After a brief introduction which cited the older Cambrian deposits of Vermont and the presumptive evidence that the Adirondack crystallines were a land area, carved by erosion during Cambrian time, slides of topographic maps colored hypsometrically as well as geologically were thrown on the screen and the facts on which the conclusions were based were thus illustrated, due allowance being made for faulting. Crystalline limestones have largely determined the valleys.

In discussion M. R. Campbell inquired if any variety in the basal Potsdam had been noted in different regions, to which the speaker replied that on the east and southeast almost none were apparent. R. S. Tarr remarked the parallel conditions in New Jersey, where, however, folding has supervened. H. P. Cushing described similar phenomena on the north side of the Adirondacks, and especially outliers of crystallines entirely surrounded by Potsdam, and the projection of the latter into the mountains where limestone occurred. F. D. Adams instanced the same relations in Canada around the old Laurentian protaxis, and in particular referred to the observations of Mr. Low in Labrador, showing very strikingly the gradual encroachment of Cambrian and Ordovician sediments into embayments in the old crystallines. A. C. Lane remarked the parallel phenomena in Michigan. H. F. Reid inquired about the amount to which the strata were tilted, to which the speaker replied that the Paleozoics were all notably flat and seldom reached 15 degrees.

The Society then divided into two sections. The one in which the petrographic papers and those dealing with the crystalline rocks were presented assembled in the rooms of Dr. G. P. Merrill of the Museum, the others remaining in the original hall. In the latter the first paper presented was the following, the report for which and the following is based on notes kindly taken by Prof. H. S. Williams and from the abstracts furnished by several authors.

On the Southern Devonian Formations. Henry S. Williams, New Haven, Conn.

The remarkable contrast between the northern and southern Devonian formations was shown. The former consists of a considerable number of separate formations, of differing kinds of sediments, and holding separate and distinct faunas and together

making a series of rocks several thousand feet in thickness, while the southern representations of the Paleozoic series in Tennessee and Alabama is a single formation composed of a single kind of sediment, the Black Shale, and holding, when pure, only one fauna of very few species. It occupies the whole interval between the Silurian and Carboniferous strata. In order to account for the differences the principles of (a) difference of origin for rock: (viz. (1) organic and (2) fragmental), and (b) the sorting power of moving waters were found applicable to most of the cases, but not to account for the origin of the black shales or of the Oriskany.

For the explanation of the Black Shale an origin of the sediments was found in the decay of Lower Silurian limestones composing the surface of the Cincinnati plateau, which occupied the center of the great interior continental basin. The distribution of these black shale muds was accounted for by oceanic currents. Their absence from central Tennessee and neighboring tracts was referred to the scouring of the shallows and to lack of sedimentation; the absence of other faunas to the fatal effects of the fine mud upon marine life. The time of beginning of the sediments was placed at the close of the crisis which brought in the Oriskany sediment; the black color was explained by Sargasso-sea vegetation. The Oriskany formation and its distribution from a center in eastern New York, along the northern shores of the intercontinental basin and along the eastern shores, decreasing in force with extension southward, and its absence west of the Cincinnati plateau, were explained as the result of sinking of the northeast rim of the basin in the Lake Champlain region sufficient to open communication through the St. Lawrence valley, past Montreal, with the eastern sea, and allowing of extensive wash by tidal flows through the estuary or channel, thus bringing into the basin great quantities of coarse sand and the new Oriskany fauna.

In the discussion that followed Mr. Hayes called attention to the thickening of the black shale at its extreme extension southward in Alabama, thus confirming the probability that there was land elevation in that direction during Devonian time.

A Complete Oil Well Record in the McDonald Field between the Pittsburg Coal and the Fifth Oil Sand. I. C. WHITE.

The speaker stated that a new well had been sunk at Pittsburg from the Pittsburg coal seam, 5,800 feet to or below the Carboniferous. Samples had been preserved every five feet, and the well is to go 500–600 feet deeper, making it the deepest well in America and second only to one in Germany.

Structure of the Newark Formation of Western New Jersey. HENRY B. KÜMMEL, Chicago, Ill.

The sedimentary rocks of the Newark formation in western New Jersey are divisible into three subdivisions to which the geographical names Stockton, Lockatong and Brunswick have been given provisionally. The Stockton beds are the lowest and consist of arkose conglomerates and sandstones, freestones and red shales, interbedded and many times repeated. The arkose beds are characteristic of this subdivision. The Lockatong beds are next and consist of hard, black and dark green argillites and shales with some red flagstones. The black argillites are characteristic of this division. The Brunswick beds consist in the main of soft red shales with a few sandy layers. Along the northwest boundary all three divisions lose their type character and grade along the strike into coarse sandstones or massive conglomerates. Two profound faults traverse the formation and repeat the series twice. Faults of a few feet are not uncommon. Although the

monoclinal structure prevails, low folds, particularly in the Brunswick beds, are common. A total thickness of 20,000 feet for the Newark system across New Jersey was given as the nearest estimate of the writer.

The Upper Cretaceous Formations of the Northern Atlantic Coastal Plain. William B. Clark, Baltimore, Md.

This paper was prepared in cooperation with Messrs. R. M. Bagg and George B. Shattuck, who had been Prof. Clark's geological assistants for several years. The areal distribution of the five Post-Potomac Cretaceous formations was represented upon a map on the scale of one mile to the inch, which embraced the area between New York Bay and the Potomac River. The variations in sedimentation and structural relations presented throughout this distance of over two hundred miles were described, as well as the faunal characteristics of the several formations.

The Matawan-Monmouth formations were shown to be equivalent of the Cretaceous Eutaw—Rotten Limestone—Ripley groups of Alabama; and the Pamunkey equivalent of the Eocene Lignitic—Claiborne group of the same area, so that the Rancocas-Manasquan-Shark River formations represent the interval between the Ripley and Lignitic, the first two being of Cretaceous age, the last of Eocene age.

It was also shown that the Upper Cretaceous formations of the Atlantic coast are the approximate equivalents of the Senonian and Danian, of Europe.

Notes on the Stratigraphy and Paleontology of the Laramie and Related Formations in Wyoming. T. W. Stanton and F. H. Knowlton, Washington, D. C.

I. The Ceratops Beds of Converse County. II. The coal-bearing series of the Laramie Plains. III. Localities in Bitter Creek Valley—Block Buttes, Point of Rocks, Rock Springs. IV. Evanston and Hodges Pass. V. Other localities considered—Carbon, Wyo.; Crow Creek, Colo.; Coalville, Utah. VI. Résumé.

(The undersigned (J. F. K.) learned with regret, when it was too late to remedy the matter, that no further abstract of the above paper had been obtained. He had thought it was read by title.)

Geology of Northeastern Washington. I. C. Russell.

The speaker described the remarkable cañon of the Snake River and said it equalled in grandeur the Grand Cañon of the Colorado. There are walls 4,000 feet high and a valley 15 miles across. 4,500–5,000 feet of lavas have been cut through. In the lavas secondary columnar fracturing can be detected radiating from the centers of primary columns and at right angles to the faces of the latter.

A Study of the Nature, Structure and Phylogeny of Dæmonelix. E. H. Barbour, Lincoln, Neb.

The new fossil Dæmonelix is a fresh-water fibrous alga aggregated together into various forms, the chief of which are large regular upright spirals, sometimes with, sometimes without an axis. These fossils occur in every exposure in the Loup Fork Tertiary on Pine Ridge, Sioux County, Neb. They stand invariably upright in fairly coherent sand rock. Area about 500 square miles. Vertical range about 200 feet. Structurally Dæmonelix is cellular but not vascular. It consists of simple parenchymatous tissue without trace of fibro-vascular bundles.

In its phylogenetic relations we can trace apparent development from the simple Dæmonelix 'fibre' in the lowest beds, successively through the Dæmonlix 'cakes,' Dæmonelix 'balls,' Dæmonelix 'cigars' or 'fingers,' and the Dæmonelix 'irregular' to

the Dæmonelix 'regular' of the topmost beds. Though the development is too sudden and startling, nevertheless this is in the order of occurrence.

The paper was illustrated by a superb and demonstrative series of lantern slides and was listened to with the greatest interest. The writer incidentally reviewed the various, more or less absurd, explanations of the 'Devil's corkscrews,' that had been advanced, but in the end he established his own views to the entire satisfaction of those present.

The Society at the conclusion of the paper and after being joined by the other section adjourned until the summer meeting.

The separate section having in hand the papers relating to petrography and crystalline rocks organized with Prof. Emerson as Chairman and Mr. Turner as Secretary. The first paper was the following:

Notes on the Pre-Cambrian Volcanics of the South Mountain District. FLORENCE BASCOM, Bryn Mawr, Pa.

By means of a map of the district and a new and beautifully preserved series of specimens, the textures of the old volcanic rocks, such as spherulites, flow-lines, lithophysæ, etc., were illustrated. In certain sections micropoikilitic textures were found which are secondary as contrasted with the views of Clements and Harker, who, in other localities, regard them as primary. Specimens of lithophysæ were exhibited, charged with piedmontite.

Mr. Lane corroborated the interpretation of the micropoikilitic texture as secondary in many cases on Lake Superior and the micropegmatitic as original. He emphasized the need of care in distinguishing them. Mr. Iddings remarked that some micropoikilitic textures were original and some secondary beyond question, and Mr. Cross, from his study of spherulites, corroborated the same view.

Notes on Rock Weathering. GEORGE P. MERRILL, Washington, D. C.

The paper began with a discussion of the changes, both chemical and physical, which have taken place during the decomposition incidental to the reduction of a gray, micaceous gneiss to the condition of a red, clayey soil. The facts brought out by analysis lead to a discussion of the possible formation of zeolitic minerals during the process of decomposition and their efficacy as conservators of potash, as suggested by Lemberg and Hilgard.

A series of analyses formed the basis of the remarks and showed the great loss in silica, alkalies and alkaline earths which the process had caused, while the alumina and iron oxides had largely remained. Alumina was assumed as the constant member and calculations were based on its permanence. The analyses, when recast on this basis, furnished the ground for very interesting deductions. The speaker had been led by his investigations to question the efficacy of zeolites as conservators of alkalies. A series of specimens in tubes were passed around which had been obtained by washing a sample of a given weight and settling it so as to separate the constituents according to sizes. The chief red coloring ingredient was found in the finest sediment of all. The altered Medford diabase, as well as the rock specially the subject of the paper, were illustrated in this way. The sorting had been done by Prof. Whitney, of the Department of Agriculture. In discussion J. F. Kemp remarked the permanence of iron oxide in process of alteration, which was surprising, as iron is a characteristically restless migrator, and also that phosphoric acid remained constant, whereas in stock piles of Lake Superior hematite, it may be largely leached from the upper portions to the lower in a single season. L. V. Pirsson emphasized the care that is necessary in determining alumina and mag-

nesia, the latter being often weighed with the former. He cited cases of such error, especially in German analyses. Mr. Merrill, in reply, regarding migrating iron oxide, stated that where air has free access, iron is permanent, but that below the surface it is a very restless member. As for phosphoric acid its quantity is small and it is a peculiar ingredient, not always acting the same in different suites of analyses.

Mr. Merrill's paper was a suggestive and important one and has a close bearing on the origin of soils.

The Age of the White Limestone of Sussex Co., N. J. J. E. Wolff, Cambridge, Mass., and A. H. Brooks, Washington, D. C.

After a brief review of previous work and opinions regarding this question, the authors gave the results of their own detailed work which led them to believe that the limestone is of *pre-Cambrian* age. By means of a map the areas throughout Sussex county, N. J., were outlined and the location of crucial sections indicated. These were separately plotted and interpreted as indicating fault lines along which the blue and white crystalline limestones had become mixed up together, affording apparent transitions. The thin bed of quartzite that lies below the blue Cambrian limestone was found extremely serviceable as an aid in stratigraphic work. The outcrop of it that dipped into the white limestone east of the Buckwheat mine had been shown by a recent quarry to run down into the latter, to be tapering off and to contain limestone boulders. It was regarded as produced by the filling of a crevice by the advancing sediments. The ore body was interpreted as interstratified in the limestones because its elongation conformed to the pitch of the foliation of the the metamorphic rocks. Eruptive granites cut all the latter, although not the Cambrian limestone. In discussion J. F. Kemp spoke of the difficulties of the problem and the gratification all must feel to have the relations so well explained. Although the evidence at Mt. Adam and Mt. Eve had seemed to him to favor the metamorphism of the blue limestone there, he had felt able to go no further than probability in the matter. He also commented on the very puzzling nature of the ore bodies and the strong probability that they were replacements.

The section then adjourned for lunch.

When the section reassembled after lunch the first paper read was the following presented by F. D. Adams.

Origin and Relations of the Grenville-Hastings Series in the Canadian Laurentian. F. D. Adams and A. E. Barbour, with an added note by R. W. Ells.

The paper sketched the distribution of the fundamental gneisses in Canada. In the field recently covered in Ontario the rocks were described in detail and as constituting plutonic members of various acid and basic types, now stretched and gneissoid. A map was used to show the areal distribution. The contact of the Grenville series and the fundamental gneiss is an igneous one. The carrying of the work over the intervening belt to the Hastings areas gives ground for thinking that the Grenville consists of portions of the Hastings which have become involved in the fundamental gneiss during the intrusions of the latter. There has been more or less absorption by infusion of the Grenville into the gneissic magma. An added paper by R. W. Ells described an area to the westward where similar conclusions have been reached.

In discussion C. H. Smyth, Jr., remarked the coincidence of the views expressed with his conclusions in the western Adirondacks. J. E. Wolff asked for further particulars regarding the field evidence of the intrusion of the fundamental gneiss into the lime-

stone. He also spoke of the enrichment of metamorphic rocks in the Hoosick region with albite, and therefore with soda, necessitating caution in the interpretation of analysis. Mr. Adams, in reply, described the Grenville series as made up of closely involved limestones and gneisses, the latter exactly like the fundamental ones. He stated that pegmatite dikes cut the limestones in every direction. He also said that his analyses, on which the conclusions regarding the sedimentary origin of certain of the later gneisses were based, had shown such low alkalies and high alumina as to warrant it. There could, therefore, have been no enrichment with soda. Mr. Cross cited, in comparison, the granites and gneisses of the Rocky Mountains. Mr. Iddings questioned the fact of the fundamental gneisses being the original crust. Dr. Adams replied urging its world-wide extent and fairly uniform acid character despite some more basic members. Prof. Emerson remarked on the distinction that was made between intruded fundamental gneiss regarded as older than the limestones and intruded lavas that would be called later. He raised the point that both were practically the same and that if an intruded lava were called a later rock, although it had existed in the interior, perhaps from very early time, then gneisses now found intruded should also be regarded as later. Dr. Adams, in reply, urged the conception of the original crust, and insisted that, even if after the Grenville-Hastings series had been laid down on it the great batholite softened and penetrated them, it was still to be considered older. The section evidently held diverging views on this point.

The Crystalline and Metamorphic Rocks of Northwest Georgia. C. WILLARD HAYES and ALFRED H. BROOKS, Washington, D. C.

The region discussed in the paper extends southward one hundred miles from the Tennessee line and westward twenty to eighty miles from the Atlanta meridian. It embraces about 4,000 square miles, forming a belt to the east and south of the Georgia-Alabama Paleozoic area. The rocks described consist of (1) the slates and conglomerates of the Ocoee series, (2) the granites, gneiss and crystalline schists of the Piedmont basal complex, and (3) a series of intrusives including granite, diorite, gabbro.

By means of maps colored to show the distribution of the rocks, their areal relations were outlined and many interesting points were adduced, not the least of which were those connected with the intrusive granites, so prominent east of Atlanta at Stone Mountain.

Dr. A. C. Lane asked about the intruded rocks and if there were contact zones. Mr. Brooks replied that there were zones of ottrelite and andalusite schist around both granites and diorites. Mr. Keith also inquired about certain stratigraphical relations.

The Grain of Rocks. ALFRED C. LANE, Houghton, Mich.

The grain of rocks is dependent on the chemical composition and the causes that produce solidification, cooling, gas diffusion, etc., the general law being, the more rapid the action the finer the grain. The paper discussed the grain from the threefold standpoint of theory, observation upon the Keweenawan rocks and experiment.

In regard to chemical composition, the augite of the melaphyres shows plainly the empirical law that the less there is of it the finer is the grain, other things being equal.

The mathematical laws of cooling were applied to an indefinite sheet and the following laws deduced and tested:

(a) The case where we consider the adjacent rock symmetrically heated by the

sheet can be solved by aid of a solution for the case wherein the walls are kept at a fixed temperature. For the temperature at any point of the affected zone is the same as an average temperature obtained from two points as follows: If we imagine a hypothetical dike of the same breadth as the zone affected in the original sheet, and conceive of its walls being kept at a constant temperature, and if we imagine the two points situated at the same distance from the walls of the dike as was the original point whose temperature was sought in the original sheet, the average of the temperatures of the two points will be the value sought. The sum will be used when the original point lies within the hypothetical dike, and the difference if it lies without. We need, therefore, to consider in detail only the case where the sides of the sheet are kept at a fixed temperature.

(b) Taking therefore this case of a sheet originally of a uniform temperature we can divide the cooling into three periods:

1. Before the center has cooled appreciably. During this time the time of cooling is as the square of the distance of the margin, and is otherwise independent of the sheet.

The augite of the Keweenawan ophites follows in its grain this law, the average area of cross sections being proportional to the square of the distance from the margin and independent of the size of flow. Consolidation in this period may be expected to be especially characteristic of effusive rocks.

2. While the center is cooling down one-fourth of original difference in temperature between sheet and margin. This period is about four times as long as the first.

3. Thereafter the rate of cooling when a given temperature is reached will be independent of the position of a point. Hence the grain will be uniform and the same for all parts of the sheet that consolidate in this period. The solidification will tend to to fall into this period for high initial temperatures of the magma and hot walls, compared with the temperature of solidification and broad contact zones. Hence solidification in this period may be taken as typical for abyssal rocks.

Dikes of the Keweenawan in the Huronian show a marginal zone where the grain appears to have been formed in the first period of solidification, and a central belt where the solidification appears to have been in the third period. Throughout, the augite follows the theoretical laws most sharply, while porphyritically formed components are less tractable.

In illustration the speaker showed the results of experiments with sulphur and with candy, and found that they corresponded to his propositions. Slides were passed around, made from luster-mottled melaphyrs to bring the points out. (The abstract of Dr. Lane's paper is somewhat obscurely worded under (a), and it is possible that the undersigned has not accurately expressed it. The direct application lies in this: If we can measure in a diabasic dike or sheet the distance of the zone of even grain from the walls, then, knowing as we do the fusing point of augite, we can calculate the initial temperature of the dike or sheet at time of intrusion.)

In the concluding paper of the session Prof. Emerson described some peculiar phenomena that he had observed in the trap sheets of the Connecticut Valley. In certain flows, mud in streams and chunks had become so involved that it had made the trap a mass of glass and sediments. Steam, supposed to have been evolved from wet rocks under the lava flow by its heat, had boiled up through the lava and made other curious mixtures. These and the alterations resulting were described and illustrated by thin sections.

The Section then adjourned and joined the rest of the Society.

The following titles were also announced, but were not read, chiefly because of the absence of their authors. In several instances they were read by title:

Evidences of Northeasterly Differential Rising of the Land along Bell River. ROBERT BELL, Ottawa, Canada.

Surface Tension of Water as a Cause of Geological Phenomena. GEORGE E. LADD.

Geomorphy of Jamaica as Evidence of Changes of Level. J. W. SPENCER, Washington, D. C. (By title.)

Preliminary Note on the Pleistocene History of Puget Sound. BAILEY WILLIS, Washington, D. C.

Modified Drift in St. Paul, Minn. WARREN UPHAM, St. Paul, Minn.

Note on Plasticity of Glacial Ice. I. C. RUSSELL.

Physical Basis for General Geological Correlation. CHARLES R. KEYES, Jefferson City, Mo.

Notes on the Potsdam and Lower Magnesian Formations of Wisconsin and Minnesota. JOSEPH F. JAMES, Hingham, Mass.

The Age of the Lower Coals of Henry County, Missouri. DAVID WHITE.

New Evidence on the Origin of Some Trap Sheets of New Jersey. HENRY B. KUMMEL, Chicago, Ill.

The Origin and Age of the Gypsum Deposits of Kansas. G. PERRY GRIMSLEY, Topeka, Kansas. Read by title.

On the whole the meeting was a most enjoyable one, and the 75 to 100 Fellows who were in attendance returned to their homes with appreciative and grateful feelings to the geologists of Washington, by whom they had been so hospitably entertained.

J. F. KEMP.

AMERICAN MATHEMATICAL SOCIETY.

THE annual meeting of the American Mathematical Society was held in Hamilton Hall, Columbia University, on Wednesday afternoon, December 30, 1896. The President, Dr. George W. Hill, occupied the chair, and there were twenty-four members in attendance. Profs. T. W. Edmondson and J. L. Patterson were elected to membership. The Secretary's report showed a total membership of 279, being a net gain of 12 for the year. Reports were also received from the Librarian and the Treasurer. The *Bulletin* of the Society has appeared regularly through the year, being at present in the sixth annual volume. The last complete volume is a substantial octavo of 354 pages.

The annual election was held at this meeting, the following ticket being adopted: President, Prof. Simon Newcomb; Vice-President, Prof. R. S. Woodward; Secretary, Prof. F. N. Cole; Treasurer, Prof. Harold Jacoby; Librarian, Prof. Pomeroy Ladue; Committee of Publication, Prof. T. S. Fiske, Prof. Alexander Ziwet, Prof. Frank Morley; Members of the Council to serve until December, 1899, Prof. Alfred Baker, Dr. George W. Hill, Dr. Emory McClintock.

Three papers were presented, abstracts of which are given below.

Prof. Morley, of Haverford College, read a paper on the construction of a single point covariant with five given points. Taking the five points 1, 2, 3, 4, 5 on a conic, U, and taking Gundelfinger's conic for any four, let the intersection of the polars of the fifth point with respect to the two conics be found; the 5 points so obtained lie on a line which strikes U at the zeros of a quadratic covariant, Salmon's S. By taking the polar of the five points with regard to this covariant pair, counted thrice, we obtain a covariant point, readily identified as the second of Salmon's list. For

this a geometric construction was given. The constructions involve the ruler alone, as is proper when a single point is to be found.

Prof. Alexander S. Chessin, of the Johns Hopkins University, gave a brief account of his investigations on the motion of a physical pendulum, taking into account the rotation of the earth about its axis. He showed that when the relative velocity of the pendulum is zero, as in the famous experiment of Foucault, the motion of the axis of the pendulum can be represented as composed of two simultaneous motions: (1) of the motion on a very flat closed conic surface, this surface having a plane of symmetry which would be the plane of oscillations of the pendulum, but for the disturbance due to the rotation of the earth; and (2) of the rotation of this conic surface about the vertical of the point of suspension.* The conic surface being very flat, it will seem to an observer as if the axis of the pendulum oscillated in the plane of the vertical of the point of suspension, while at the same time this *apparent* plane of oscillations rotated about the vertical. In Foucault's experiment the rotation of the apparent plane of oscillations took place *clock-wise*. Prof. Chessin showed that this rotation depended on the construction of the pendulum; namely, if the pendulum be properly constructed and the amplitude of oscillations be sufficiently great, then the rotation of the apparent plane of oscillations could take place as well *clock-wise* as *contra clock-wise* or even *not take place at all*. This interesting phenomenon could be observed best at places near the equator, because the angular velocity of rotation of the apparent plane of oscillations is composed of two terms, one proportional to the *sin*, the other to the *cos* of the latitude of the place of observation. The contra clock-wise rotation is due to the presence of the cosine term and is maximum on the equator. In concluding, Prof. Chessin emphatically urged experiments which would verify his calculations.

Prof. E. W. Brown, of Haverford College, made a brief statement of the progress of his calculation of the solar inequalities in the lunar theory. The motion of the node was compared with Hansen's result and with that given by observation. An explanation was also given of the slow convergence of the series which represents the principal part of the secular acceleration of the moon's mean motion.

Following a pleasant custom of previous years, several of the members dined together after the meeting.

F. N. Cole,
Secretary.

* See *American Journal of Mathematics*, Vol. XVII., p. 86; Johns Hopkins University Circulars, Vol. XIV., No. 118, p. 64.

CURRENT NOTES ON ANTHROPOLOGY.

DIVINATORY AND CALENDRICAL DIAGRAMS.

At the American folk-lore meeting Mr. Stewart Culin exhibited and explained several divinatory diagrams from Thibet, China and Corea, and called attention to their close similarity to the so-called 'calendar-wheels' and the *tonalamatl*, or book of days, of ancient Mexico. He pointed out that the fundamental conceptions of both are identical, and that both developed into games, such as *parcheesi* in India and *patolli* in Mexico, the Chinese game of 'promotion,' and the European 'game of goose.'

These all begin with the numerical concept of the four, expressed in four arms, like a cross, or four 'houses' or squares, which latter, by multiplication, may be 12, 16, 64, etc. This primary concept expressed the original notion of the 'four quarters,' *i. e.*, of the world, and, by extension of the cosmos, time as well as space. The relation of each individual to the All was the notion which imparted the divina-

tory character to the diagram, and was as common in Central America, where it gave rise to the sacred 'year' of 260 days, as in many parts of the Old World. Such calendars were not originally time-measurers, but divining schemes, as Sahagun expressly states.

THE RACIAL GEOGRAPHY OF EUROPE.

THE complex and historically important subject of the geographical distribution of racial types in Europe has been closely studied by Prof. W. Z. Ripley, and will be made the theme of a series of articles in the *Popular Science Monthly*, beginning with the February number. The articles will be amply illustrated by maps, diagrams and some fifty hitherto unpublished portraits of race types reproduced from original photographs. Having had the advantage of looking through Prof. Ripley's collections upon this branch of anthropology, I feel sure his articles will add much new material and many valuable suggestions to a comprehension of the racial questions of modern Europe. Such points as the cephalic indices, the distribution of blonds and brunettes, the comparison of stature and weight, etc., when studied from hundreds of thousands of individual measurements, must lead to results more secure, and perhaps quite differing from those hitherto published.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

IN the last number of the *Chemical News*, Prof. John Waddell, of the Canadian Royal Military College, describes a large number of experiments on the permeability of various elements to the Röntgen rays. He concludes "that the elements may be divided into two classes, those of low atomic weight and those of higher atomic weight, the transition taking place between the atomic weights of 30 and 40. Among the higher elements the opacity is probably not far from being proportional to density, but with elements of low atomic weight the same law does not hold; sodium, for instance, is decidedly more permeable than aluminum; lithium and sodium are more nearly alike. Metals and non-metals cannot be differentiated from each other; boron is less permeable than sodium, and sodium is less permeable than oxygen."

THE cause of poisoning from wall papers containing arsenic has often been ascribed to the formation of arsin (arsenetted hydrogen) by the action of mould on the paper. An account is given in the last Berichte of a number of experiments carried out by O. Emmerling bearing on this subject. Several different kinds of bacteria were grown in cultures containing arsenic, and in no case was arsin present in the gases evolved. The same was true when several different species of moulds were used. A moist arsenical paper was exposed in a tube in a current of air till it had on it numerous colonies of moulds, yeasts and bacteria. The air was drawn through a silver nitrate solution and no trace of arsin was present. Hence it would seem that danger from arsenical wall papers is not from the formation of arsin, but from particles of dust given off from the paper. Happily, few wall papers are at present manufactured containing arsenic.

IN a letter to *Nature* (Nov. 26), on the subject of osmotic pressure and ionic dissociation, Prof. Henry E. Armstrong uses these words: "There can be no doubt that in so far as *weak solutions* are concerned, a law has been discovered which is broadly true *in mathematical form;* yet I have no hesitation in asserting that the fundamental premises on which it is based are destitute of common sense, in the opinion of those who look at these matters without leaving chemical experience out of ac-

count." "I am a determined opponent of what I think may fairly be termed the *nonsensical hypothesis of ionic dissociation* (italics ours), for there is no other appropriate term for a view which asserts that hydrogen chloride and a few other compounds are so loosely strung together that they fall to pieces when dissolved in water; out of sheer fright, it would seem, as no valid motive is suggested for such self-sacrifice; and no such charge of unprincipled levity of conduct is brought against the vast majority of compounds other than a few acids and alkalies." If there are others who oppose the theory as strongly as Prof. Armstrong, they at least have not the temerity to attack it so boldly in the face of its tacit general acceptance in the chemical world.

In the December Journal of the American Chemical Society, George F. Payne discusses the mineral constituents of the watermelon. He finds in the ash over sixty per cent. of potash and ten per cent. of phosphoric acid; hence the need of fertilizers containing a large quantity of potash.

J. L. H.

ASTRONOMICAL NOTES.

We have received a new book on the determination of planet and comet orbits by Dr. Karl Zelbr. It contains 125 octavo pages, and is reprinted from the first volume of Valentiner's *Handwörterbuch der Astronomie.* It will doubtless be found a very useful text-book of the subject.

The *Astronomical Journal* of December 10th contains a series of observations of the companion of Sirius made at Washington last March by Prof. Stimson J. Brown. At the time of making these observations Prof. Brown did not consider them entitled to very much confidence, on account of the extreme difficulty experienced in seeing the companion so near the principal star. It is now evident, however, from the later observations at the Lick Observatory, that the Washington observations are correct, and that the object seen by Prof. Brown was really the companion.

In the *Astronomische Nachrichten* of December 14th Prof. E. C. Pickering has a note on a method of determining the relative motions of stars in the line of sight by means of spectra photographed through an objective prism. The plan consists of making a pair of photographs of the same region near the meridian in reversed positions of the telescope. As the reversal of the telescope turns the spectra 180°, we can measure on the photographs twice the linear displacement due to the relative motions of any two stars in the line of sight. The second photograph is made through the glass plate, so that the plates may be placed with their films in contact for making the comparisons.

Among recent series of meridian circle observations of which preliminary accounts have appeared in the astronomical periodicals, we notice the following: In the *Astronomical Journal* of December 23rd Prof. Tucker gives a summary of the results of his determinations of fundamental stars contained in the astronomical ephemerides other than the *Berlin Jahrbuch.* In the *Astronomische Nachrichten* of December 22d Prof. Küstner gives his determinations of the *Zusatzsterne* of the *Berlin Jahrbuch* list, made with the meridian circle of the Berlin observatory in the years 1886 to 1891.

H. J.

SCIENTIFIC NOTES AND NEWS.

Gen. Francis A. Walker, President of the Massachusetts Institute of Technology and Vice-President of the National Academy of Sciences, died suddenly on January 5th. He was born on July 2, 1840, and graduated from Amherst College in 1860. He had filled many important positions, having been professor of political economy in the Sheffield Scientific School of Yale University, Chief of the Bureau

of Statistics, Superintendent of the Census and Commissioner of Indian Affairs. Gen. Walker made numerous and valuable contributions to statistics, sociology and political economy.

WE regret also to announce the deaths of Dr. Joseph v. Gerlach, formerly professor of anatomy in the University at Erlangen; of Dr. Charles Heitzmann, the distinguished New York histologist; of Prof. Wm. H. Pancoast, an eminent Philadelphia surgeon; of the Count de Mas-Latre, the author of numerous contributions to paleography; of Mr. W. H. Ward, of Newark, N. J., a student of horticulture; of Mr. Vivian S. Martin, the geographer, and of Sir John Brown, who made important improvements in the manufacture of armor plates and railway supplies.

QUEEN VICTORIA has conferred an honor on the English peerage by making Sir Joseph Lister a lord.

PROF. FRANCIS DARWIN is preparing to publish a supplementary series of Charles Darwin's letters. His projected volume will include a full selection from those letters of a purely scientific interest which he was unable to print in the 'Life and Letters,' as well as from any fresh material that may now be intrusted to him. Those of Darwin's correspondents who have not already done so are requested to allow him to make copies of any letters of his which they possess, even though they are apparently of only slight or restricted interest.

MR. HERBERT SPENCER has consented, in response to a letter signed by a large number of eminent Englishmen, to allow his portrait to be painted and presented to the nation. Mr. Hubert Herkomer has been selected as the artist.

THE Arago medal, so seldom given by the Academy, was this year awarded both to Lord Kelvin and to M. Antoine d'Abbadie.

THE public meeting of the Paris Academy of Sciences on December 21st was of special importance. An address was made by the President, M. A. Cornu, and the prizes of the Academy were awarded. These prizes are very numerous and valuable, and the issue of the *Comptes Rendus* containing the account of their award is of much interest. The grounds of each award is given in detail by an eminent authority, and the hundred pages of the number thus give a valuable summary of the advances in certain departments of science.

THE Royal Geographical Society of London has awarded a special gold medal to Dr. Fr. Nansen and special silver medals to Captain Sverdrup, Lieutenants Scott-Hansen and Johannsen and to Dr. Blessing. The other members of the recent Polar expedition were each awarded bronze medals.

IT is now reported that the large fortune left by Alfred Nobel will be used to endow five international prizes to be awarded annually, one of these for the most important advance in physics, one in chemistry, one in physiology or medicine, one for the best compilation in physiology or medicine, and one for the most important contribution towards the promotion of peace.

MR. JOHN LEIGHTON will present to the Royal Institution, London, his collection of letters and papers by Faraday, which consist chiefly of letters written to Frederick Magrath. Faraday left his personal papers to the Royal Institution, and they now are contained in a special cabinet.

THE trustees of the British Museum have secured the important collection of woodpeckers and other birds formed by the late Mr. Edward Hargitt. The number of specimens of woodpecker alone is nearly 3,600, including all the valuable types described by Mr. Hargitt in his 'Catalogue of the Woodpeckers,' and there are also 2,000 miscellaneous birds.

MRS. COXE has presented the scientific library of the late Eckley B. Coxe to Lehigh University. The collection is rich in complete sets of scientific periodicals and in the transactions of learned societies.

THE foreign papers contain detailed accounts of the interment of Pasteur at the Pasteur Institute on December 26th. His remains had for fifteen months been lying at Notre Dame, where a religious ceremony was held before removing them to the Institute. The crypt, planned by M. Giraud, following the tomb of Galla Placadia at Ravenna, is inscribed with a sentence from Pasteur's reception speech at

the Academy: "Hereux celui qui porte en soi un dieu, un idéal de beauté, et qui lui obéit—idéal de l'art, idéal de la science, idéal de la patrie, idéal des vertus de l'évangile." Brief remarks were made by M. J. B. Pasteur; M. Bertrand, President of the Council; M. Rambaud, Minister of Education; M. Bodin, President of the Municipality; Sir Joseph Lister, representing the Royal Society; Sir Dyce Duckworth, Sir John Evans, Prof. Crookshank, Sir. W. Priestley, representing the Universities of Edinburgh and St. Andrews; M. Cornu, for the Academy of Sciences; M. Bergeron, for the Academy of Medicine; M. Perrot, for the Normal School; M. Louis Passy, for the Agricultural Society; M. Tissier, for the medical students, and M. Duclaux, Director of the Pasteur Institute.

THE *British Medical Journal* states that the question of the appointment to the chair of physiology in Geneva, vacant by the death of Prof. Moritz Schiff, is exciting some attention in Paris. Amongst the candidates are stated to be Prof. Herzen, of Lausanne; Prof. J. R. Ewald, of Strassburg, son-in-law of Prof. Schiff; Dr. Langlois, assistant in the Physiological Department of the Medical Faculty in Paris under Prof. Richet, and well known for his researches on heat and the suprarenal capsule; Dr. Contjean, one of the staff at the Museum, under Prof. Chauveau, known for his researches on secretory nerves and his other contributions to physiology. Other names are mentioned, but it is evident that with Prevost as a possible successor, and the candidates already mentioned, a worthy successor to Schiff will readily be found.

DR. CHARLES WARDELL STILES has been appointed by the State Department a special commissioner to report on the parasitic diseases of seal life.

THE government of Western Australia decided about a year ago to erect an observatory at Perth at a cost of $25,000. Mr. Ernest Cooke, the government astronomer, has recently been in England purchasing the necessary instruments.

A REMARKABLY violent cyclone has practically demolished the town of Nevertire in New South Wales. The casualties were numerous, but are not fully known, as the telegraph line has been destroyed.

A LANDSLIDE has occurred at the village of Stanna, in the province of Modena, Italy, destroying a large number of buildings.

A SERIES of lectures and conferences upon the educational value of science in the common schools will be held at Teachers' College, New York, as follows:

The educational value of biological science (botany, zoology and physiology). Prof. Henry F. Osborn, of Columbia University. January 14th, 3 p. m.

The educational value of physical science (physics and chemistry). Prof. Ira Remsen, of Johns Hopkins University. Thursday, January 21st, 3 p. m.

The educational value of geological science. Prof. B. K. Emerson, of Amherst College. Thursday, January 28th, 3 p. m.

The Curriculum. Pres. J. G. Shurman, of Cornell University. Friday, January 29th, 3 p. m. (This date is liable to be changed.)

The lecture in each case will be one hour in length, followed by a conference lasting, perhaps, one hour. The purpose of these lectures and conferences is (1) to arouse due appreciation of the study of science, (2) to give helpful suggestions to those who are engaged in teaching science, and (3) to aid in determining the relative importance of these subjects in courses of study.

PROF. DANIEL G. BRINTON will deliver a course of six lectures on 'The Religions of Primitive Peoples,' at New York University, on successive Tuesday evenings, beginning January 12th, at 8 p. m. The lectures will be published by G. P. Putnam's Sons, as Volume II. of the Series of American Lectures on the History of Religions.

Natural Science expects to publish next month an account of flints discovered by Mr. J. Lewis Albert and exhibited at a recent informal smoking evening of the London Geological Society. They are said to be the work of man, though obtained from the Cromer Forest bed at Runton, regarded as forming the top of the Pliocene Series. No one has hitherto professed to find in Great Britain the remains of man at so low a horizon.

THE article entitled 'Biographical Notes on

Pasteur' by Dr. Jules Marcou, published in the issue of this JOURNAL for December 6, 1895, has been translated into French and Spanish and has been distributed by order of the government of Nicaragua to all schools and public institutions of that state.

PROF. HOLDEN will contribute to an early number of *Harper's Weekly* an illustrated article on the Lick Observatory.

MR. J. E. HARTING has resigned from the editorship of the *Zoologist*, which he has conducted for twenty years, and is succeeded by Mr. W. L. Distant.

AT the beginning of the new year the *Naturwissenschaftliche Rundschau*, edited by Dr. W. Scklarek and published by Friedrich Vieweg & Sohn, Brunswick, announces as cooperating editors Dr. J. Bernstein, professor of physiology at Halle; Dr. W. Ebstein, professor of pathology at Göttingen; Dr. A. v. Koenen, professor of paleontology at Göttingen; Dr. Victor Meyer, professor of chemistry at Heidelberg, and Dr. B. Schwalbe, professor of anatomy at Berlin. The new volume is printed on improved paper, presenting a much more pleasing appearance than is usual in German publications. The *Naturwissenschaftliche Rundschau* usually contains one scientific paper, but is chiefly made up of reviews of scientific literature, written with care and impartiality and giving an excellent survey of the progress of science.

THE British government will send, in January, a commission, consisting of Generál Sir Henry Wylie Norman (Chairman), Sir Edward Grey, Bart., and Sir David Barbour, to inquire into the conditions and prospects of the West India sugar-growing colonies. Mr. Daniel Morris, Assistant Director of the Royal Gardens, Kew, will accompany the commission as expert adviser in botanical and agricultural questions. *Nature* calls attention to the fact that the appointment of Mr. Daniel Morris as scientific adviser is a proof that Kew has been working for the last quarter of a century on the right lines and that its policy is a sound one. Of all the colonies in the West Indies, Jamaica is said to be the only one in a fairly prosperous condition. This has been brought about mainly by the work of the Botanical Department and the encouragement given by it to improve agricultural methods and introduce new industries.

PROF. RICHARD E. DODGE, Teachers' College, New York, will edit a *Journal of School Geography*, the first number of which will appear during the present month. Prof. Dodge will be assisted by a board of editors consisting of William M. Davis, professor of geography at Harvard University; Dr. C. W. Hayes, geologist of the U. S. Geological Survey; Dr. H. B. Kümmell, Lewis Institute, Chicago, Ill.; Dr. F. M. McMurry, of the School of Pedagogy at Buffalo, and Mr. R. DeC. Ward, instructor in climatology at Harvard University. The journal will be issued monthly, with the exception of July and August, and each issue will contain about thirty-two pages of reading matter. Specimen copies will be sent, so far as the edition will allow, on application to Prof. Dodge.

THE current number of *Natural Science* gives the following news concerning recent scientific expeditions: Prof. Penzig, of Genoa, editor of *Malpighia*, has undertaken a botanical expedition to Buitenzorg, Singapore and Ceylon. Dr. Grünling, Curator of the Mineralogical Collection in Munich, has gone to Ceylon on an exploring expedition. Mr. Bastard, who is exploring in Africa, has been prevented by the trouble in Madagascar from penetrating into the interior or that island. He has, however, made good collections of fossils, also anthropological measurements and photographs. Mr. Voillot has returned from a voyage to Haute Mamberé; he brings with him ten Baya skulls and an interesting ethnographic collection. Another valuable anthropological collection is that brought back from Russian Asia by Mr. E. Blanc. Of Mr. Alexander Whyte's explorations in the Karonga Mountains in Central Africa, the results include 6,000 dried specimens of plants, 5,000 land shells, 3,000 insects, numerous mammals, reptiles, geological collections, and so on.

FELIX ALCAN, Paris, has begun the publication of a *Bibliographia Physiologica*, compiled by Prof. Ch. Richet and several assistants. The bibliographies for 1895 and for the first half of

1896 have been issued nearly simultaneously, and it is proposed not only to continue their publication, but also to cover preceding years. Prof. Richet is a zealous advocate of the Dewey decimal system of classification and applies it systematically in the new bibliography. It is printed on one side of the paper only, and the index numbers, sometimes extending to six decimals, are prefixed to each entry. A special volume has been issued giving the classification for physiology, which is somewhat bewildering, as the fifteen hundred publications indexed for a year may be divided among one million classes. When the entries are cut up and made into a card catalogue different years may be combined conveniently, but the separate volumes lose half of their usefulness in that they have no alphabetical index of authors' names. The *Bibliography* is confined to physiology in its narrower sense, excluding subjects such as embryology, histology and bacteriology. There are naturally omissions and errors, but the *Bibliography* will serve a most useful purpose pending the establishment of an international bibliography of the sciences.

At a meeting of the Boston Society for Medical Sciences on December 15th Dr. C. S. Minot described an improved microtome, made for him bythe Bausch and Lomb Optical Company, which is entirely novel in its construction and works with great precision. The model adopted has been chosen: 1st. To secure the utmost steadiness and precision of movement, together with the minimum of errors. To this end, the knife is rigidly clamped at both ends upon a heavy metal frame above the object, and it can be placed in any position and at any desired angle. The object holder is supported under the the knife in such a way that the knife exerts no leverage upon the object. Every part is heavily built and the ways are planed and ground to the greatest possible accuracy. 2d. To secure convenience of use, the micrometer screw bears two toothed wheels, one for automatic movement, each tooth equaling five microns, and one for hand movement by lever, with automatic adjustment, each tooth equaling two microns. The object holder is adjustable by rack and pinion in three places, and has clamping devices for clamping each of the axes and is adjustable for height also. 3d. To make a microtome to work equally well for either paraffine cutting or with alcohol (celloidin, etc.). By a simple device, alcohol falling on the object is drained off without coming in contact with the ways or micrometer screw. The knife possesses the following advantages due to the handles, being of the same cross-section as the blade; the edge is true and, being made by polishing and not by grinding, is much finer than can be ordinarily produced. Every part of the edge can be actually used for cutting in the microtome. The edge may be kept always perfect by rubbing the blade on a piece of plate-glass with Diamatine powder.

At the annual public meeting of the Paris Académie de Médecine held on December 15, 1896, the prizes offered for competition during the past year were awarded. The Saint Paul prize ($5,000), as we have already stated, was divided between Drs. Roux and Behring. *The British Medical Journal* states further that the Academy prize (£40) for an essay on the part played by heredity and contagion respectively in the propagation of tuberculosis was divided between M. Georges Kuss and Dr. Aussett. The Capuron prize (£56) for an essay on the influence of diseases of the lungs in the mother upon the health of the fœtus was awarded to Dr. Chambrelent, of Bordeaux; the Civrieux prize (£40) for an essay on hallucination in mental diseases to Dr. Paul Sérieux; the Daudet prize (£40) for an essay on membranous non-diphtheritic anginæ to Dr. Jacquemart. The Falret prize (£36) for an essay on morphinism and morphinomania was divided between MM. Jacquemart, Paul Rodet, André Antheaume and R. Leroy. The Orfila Prize (£80) for a paper on the etiology of dysentery was awarded to Surgeon-Major M. O. Arnaud. The Portal prize (£30) for an essay on the lymphatic system in its relation to malignant neoplasms was divided between M. et Mme. Christiani, of Geneva, and MM. F. Barjon and C. Regaud, of Lyons. The Pourat prize (£40) for an essay on the relations between thermogenesis and the respiratory exchanges was awarded to M. F. Laulanié. The Laborie prize (£200) was divided between MM. Delorme, Mignon and Mauclaire. Other prizes, to the amount of

about £1,600, were distributed among various competitors, almost exclusively of French nationality.

THE following table gives the mumber of students from the different medical schools who passed the licensing examinations now required in the State of New York for the year ending in 1896:

Schools.	Number of Candidates.	Honor.	Per cent. accepted.
University of the State of New York	2	1	100
New York Medical College and hospital for women	7	0	100
College of Physicians and Surgeons, Columbia University	142	11	92.9
Syracuse University	24	0	91.6
Bellevue Hospital Medical College	47	3	89.3
University of Buffalo	36	0	89.2
Long Island College Hospital	64	0	87.5
Niagara University	15	0	86.6
Woman's Medical College of the New York Infirmary	7	2	85.7
Albany Medical College	47	0	85.1
Eclectic Medical College	20	3	85
New York Homeopathic Medical College	27	3	81.4
New York University	79	2	75.9

THE report of the special commission appointed by the Dutch government to discuss the scheme of draining the Zuyder Zee has been submitted. According to the *Railway Review* it states that such an undertaking is quite possible. The work would take 31 years for completion, and every year 10,000 hectares of land would be restored to cultivation. A dike 30 miles in length would have to be constructed, extending from the extreme end of South Holland to the eastern coast of Friesland. The building of this dike, 35 meters wide at the base and six meters high, will take nine years. The total cost of the work is estimated at £26,000,000, which includes the amount to be paid in indemnities to the fishermen of the Zuyder Zee. The total value of the land thus reclaimed from the ocean is estimated at £27,000,000, so that the Dutch treasury net a profit of £1,000,000, without reckoning the substantial gain to the public wealth and a corresponding increase in the annual revenues from duties and taxes.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Rev. Thomas J. Conaty will be installed as Rector of the Catholic University, Washington, on January 19th. It is expected that Dr. Conaty and Cardinal Gibbons will make important speeches outlining the policy of the University.

EX-SENATOR SAWYER, of Wisconsin, has added $5,000 to his recent gift of $25,000 to the endowment fund of Lawrence University, in Appleton, Wis.

PROF. CHARLES F. CHANDLER has retired from the professorship of chemistry and medical jurisprudence in the College of Physicians and Surgeons, but retains the professorship of chemistry in Columbia University. Prof. Thomas Egleston has retired from the chair of mineralogy and metallurgy in Columbia University, and has been made professor emeritus.

DR. KLEBS, the German pathologist, has been made professor in the Rush Medical College, Chicago, and will also occupy a position in the post-graduate medical school of the University of Chicago.

A SCHOOL of science, with twenty-seven professorships, has been founded at Madrid.

THE following appointments are announced: Dr. G. H. Bryan to be professor of pure and applied mathematics in the University College of North Wales, Bangor; Prof. E. Pringsheim to be professor of physics and Dr. Karl Friedheim to be professor of chemistry in Berlin University; Prof. Paul Staeckel, of Königsberg, to be professor of mathematics in the University of Kiel; Dr. Franz Nissl to be docent in anatomy in the University of Heidelberg.

DISCUSSION AND CORRESPONDENCE.

ON CERTAIN PROBLEMS OF VERTEBRATE EMBRYOLOGY.

I CRAVE your permission to rectify certain mistakes into which the reviewer of my recent work has fallen in his notice in SCIENCE of November 20th (p. 763). Your reviewer makes the following statements:

(1) "So far as has yet appeared, this theory (of antithetic alternation of generations in Metazoan development) rests upon the author's observation that the epidermis contributes, in early embryonic stages, to the production of nerve cells. The transformations of these cells *he has not followed*," etc., (2) "hence the whole embryo is a transient structure," etc.

(3) "The author discourses at length upon the well-known fact that in all vertebrates there is an embryonic period, at the close of which the anlages of all the principal organs are present, but not yet differentiated."

(4) "We have been unable to see that the elementary facts, which the author has collated, are anything more than what is commonly taught beginners in embryology, (5) nor to recognize that they afford any arguments to support the author's theory of 'antithetic alternation.'"

As regards the heading 1, the reviewer is apparently unaware of the existence of the completed part of my work published in April, 1896, in the Zool. Jahrb. under the title, 'The history of a transient nervous apparatus in certain Ichthyopsida—an account of the development *and degeneration* of ganglion cells and nerve-fibres.'

The work contains some of the results of six years' investigation of the matter; it was carried out on upwards of 120 embryos (out of a collection of 500 or more), whose sizes ranged from 5 mm. to 19 cm., and it is illustrated by 8 double plates containing more than 131 figures. I assert, and challenge your reviewer to prove the contrary, that in the work in question *the whole of the transformations* of these cells *to their complete degeneration* are described, illustrated and established. I have asked many competent embryologists what was their opinion on this point, and not one of them expressed anything but the conviction that I had completely established the transient nature of the ganglion cells. Hence I conclude that the reviewer must have been dreaming when he wrote "it may be questioned whether *a failure to study the fate of certain cells* in an embryo is a sufficient basis to construct a revolutionary theory upon." When I wrote my work upon them I had *only studied them for six years!*

(2) No such foolish idea as that mentioned in the review, to wit, that 'the whole *embryo* is a transient structure,' has ever entered my head as any time. What I believe, and what I have written more than once, is that there is in the development of every vertebrate a more or less reduced larva or '*phorozoon*' of a transient nature, that an embryo or sexual generation could be transient has never yet occurred to myself, or to anyone else, so far as I am aware.

(3) This is supposed to be a criticism on what I have discribed as the 'critical stage' or phase. The reviewer considers that there is no new discovery in this, but he adduces no evidence for his belief, that it is 'a well known fact,' and that what I have brought forward is nothing more than what is taught beginners in embryology.

If it be a well-known fact, this existence of a corresponding period in the development of vertebrates, and (4) if the facts I have described be such as are usually taught beginners in embryology, surely there must be evidence of it in some of the text-books of embryology. There is certainly no evidence of this 'well-known fact' in the *literature* of embryology, beyond the few lines I have cited from His regarding the human embryo, and, although I am pretty well acquainted with the more important current text-books, I have never been able to find anything in any of them, not excluding Minot's volume, bearing on the matter.

Why, moreover, within the past few years, should Keibel and Oppel, who are well versed and skilled, working and teaching embryologists, have spent so much time and labor in searching for corresponding phases in embryos of different vertebrates, and why should they have failed to find my critical phase, if it were already known to exist? Founding on these researches and my own, I state that there is only one such corresponding phase in the development and that it was first described in the pamphlet under consideration. If your reviewer questions the truth of this, let him produce his evidence. I believe, and the contrary has still to be proved, that my pamphlet contains the following novelties, fate of the yolk, yolk-sac and merocytes, discovery of a corresponding critical phase in the development of

various vertebrates, explanation of the premature birth of the opossum, the main outlines of the history of the mammary glands and placenta and a number of other items.

It was published and appeared as a separate work, because it was felt that the facts described were sufficiently novel and important to warrant such a course, and not merely 'to secure attention' to my theory. The 'note of personal exultation' is no such theory; it is intended to be an invitation and challenge to scientific men to examine and, if possible, to refute my arguments. The latter is something the reviewer has carefully avoided to attempt.

The last paragraph cited (5) is merely the expression of the critic's personal opinion and, unless supported by argument, can carry no conviction. The reviewer offers no reasons for his adverse judgment; until he does so, it is out of question to consider, or even to understand, what standpoint he takes up. A mere denial of the truth of my theory is not argument, but dogmatism.

J. BEARD.

UNIVERSITY OF EDINBURGH.

MR. BEARD'S paper on the transient nervous system was well known to me, and I consider my statements correct, and I made them deliberately. There are two methods, and only two, that enable the investigator to trace the forms and connections of nerve-cells, the Golgi method and the methylen-blue method. Mr. Beard employed neither of these, and, as a matter of fact, has not traced, and was necessarily unable to follow, all the essential transformations of these cells. His research is an extremely interesting one, and, in my opinion, important, but the results are not available in support of the 'Phorozoon' theory. The number of embryos and of years devoted to the research do not make up for the exclusive use of an insufficient method.

The facts referring to the condition of the organs at the 'critical stage' are given more or less fully in all embryological text-books. The occurrence of the critical stage is not specially mentioned, because no embryologist, except Beard, has heretofore regarded it as more or less important than preceding and subsequent stages. The error of Mr. Beard's, which I note, is the assumption that this stage is 'critical,' for stages before it and after it could equally well be selected and traced through the vertebrate series as accurately as the 'critical' stage. If Mr. Beard knows the contrary of this he must have compiled the characters of various classes of vertebrates at other stages and found that they do not agree. The detailed publication of such a compilation must precede a claim for serious attention to his hypothesis. As stated in the notice of Beard's work, the compilation of characteristics in vertebrate embryos of various classes and all approximately at the same stage is useful, and if corresponding tables of other stages were also compiled they would also be useful. It would be interesting to know what proof establishes the 'critical' nature of the stage selected by Mr. Beard. He has not as yet published any such proof, although the *onus probandi* is his. He calls for disproof, but proof from him must come first. Mr. Beard states that he compiled the facts, yet complains that I say the facts are well known. Does he mean that the facts he quotes from various authors were unknown? My review is a protest against two tendencies: first, to solve, embryologically, morphological problems without sufficient regard to histogenesis; second, to push speculation indefinitely beyond observation. Both tendencies have been marked in Mr. Beard's previous papers, as well as in the one under discussion.

I regret that my criticism cannot be more favorable.

CHARLES S. MINOT.

SCIENTIFIC LITERATURE.

The Survival of the Unlike. A collection of Evolution Essays suggested by the study of domestic plants. By L. H. BAILEY. New York, The Macmillan Company. 1896. 515 pp. 8vo.

Whatever Professor Bailey writes is interesting reading. He has the rare gift of an entertaining style, and what he writes people want to read. All his previous books have been widely read, and this will prove to be no exception to the well-established rule. The secret of this popularity, if there be any secret about it, is that when he writes he has some-

thing new to say, something based upon experiences and observations. These are by no means all his own, for he has the ability to see with the eyes of other people, as well as with his own. He is thus able to bring into his pages a rich mass of new matter which gives them additional interest and value.

This new book consists of essays and papers, all of which have been presented elsewhere and are now brought together in accordance with the author's plan. Thus, while a collection of essays, it is not without unity. "In making these essays," the author says in his preface, "I have constantly had in mind their collection and publication, and have therefore endeavored to discuss the leading problems associated with the variation and evolution of cultivated plants, in order that the final collection should be somewhat consecutive."

The following sentences from the preface will give the reader a general idea of the author's position. "The underlying motive of the collection is the emphasis which is placed upon unlikenesses, and of their survival because they are unlike. The author also denies the common assumption that organic matter was originally endowed with the power of reproducing all its corporeal attributes, or that, in the constitution of things, like produces like. He conceives that heredity is an acquired force, and that, normally or originally, unlike produces unlike." The author's *a priori* reasons for belief in the hypothesis of evolution are "the two facts that there must be struggle for existence from the mere mathematics of propagation, and that there have been mighty changes in the physical character of the earth, which argue that organisms must either have changed or perished." On the other hand, "the chief demonstrative reason for belief in evolution is the fact that plants and animals can be and are modified profoundly by the care of man."

The body of the book is in three 'parts,' the first including essays touching the general fact and philosophy of evolution; second, those expounding the fact and causes of variation, and third, those tracing the evolution of particular types of plants. The first essay gives name to the book. In it the author discusses (1) the nature of the divergences of plants and animals, suggesting the *Mycetozoa* as the point of divergence; (2) the origin of differences, holding that all plants and animals came from one original life-plasma which had the power of perpetuating its physiological but not its structural identity; no two organisms ever being exactly alike, it follows that unlike produces unlike; (3) the survival of the unlike, this being an extension of our notion of the meaning of the phrase 'the survival of the fittest,' by showing that the fittest are the unlike.

The author gives us some interesting pages on the species dogma, in which he pointedly shows the inconsistency of those who demand experimental evidence of the evolution of a species, and yet reject 'horticultural species' because they have been produced under cultivation. Many examples are given of the origination of well-marked 'varieties,' which are more different from the species from which they sprung than are the recognized species from one another. Here Professor Bailey's experience as a horticulturist enables him to cite striking examples of what the candid reader must admit are good species evolved through man's selection. Thus we seem to have made species of of beans (*Phaseolus*), tomato (*Lycopersicum*), maize (*Zea*), soy-beans (*Glycine*), etc. The horticulturist who is familiar with the plasticity of plants, and who is accustomed to see new and persistent forms arise, cannot help being an evolutionist, nor can he help being impatient with the botanist who refuses to accept such forms as true varieties or species, as much entitled to recognition as those whose origin we do not happen to know.

Charles E. Bessey.
The University of Nebraska.

A Popular Handbook of the Ornithology of Eastern North America. By Thomas Nuttall. 2d Revised and Annotated Edition, by Montague Chamberlain. With additions and 110 illustrations in colors. Vol. I., The Land Birds. Vol. II., Game and Water Birds. Boston, Little, Brown & Company. October, 1896.

For more than half a century students of North American ornithology have had three works which by common consent came to be

regarded as classics. To lovers of birds the names of their authors, Audubon, Wilson and Nuttall, are as familiar as those of Milton, Dante and Shakespeare. Nuttall's book was the less pretentious of the three, having no colored plates and selling at a price which brought it within reach of a large constituency.

Nuttall was primarily a botanist, and not a few of his admirers who know him only from the excellence of his ornithological writings will be surprised to learn that for about ten years (1825–1834) he was Curator of the Botanic Garden and lecturer on natural history at Harvard, being Asa Gray's predecessor; and that the high character of his work placed him in the front rank of early American botanists.

In seeking new plants he made an expedition into Arkansas, and afterward, in company with Capt. Wyeth and J. K. Townsend, crossed the continent from Atlantic to Pacific, following the difficult overland route later known as 'The Oregon Trail.' His field work led him into all sorts of out-of-the-way places where he was constantly meeting strange and interesting birds. That he took an affectionate interest in their doings is shown by his biographies, which are original, faithful and entertaining and show an intimate personal familiarity with the species of which he wrote. Besides, they furnished what was then so much needed, a brief narrative of the life history, breeding habits and distribution of each as at that time known. In speaking of the book a modern writer has said: "Nuttall, like good wine, does not deteriorate with age." The original edition was long ago exhausted and for many years has commanded a relatively high price—the two volumes commonly selling for $25, or even $30.

In order to keep this execellent work within reach of the ever-increasing number of students and lovers of birds, Mr. Montague Chamberlain brought out, in 1891, a new and revised edition. The new edition differed from the original in several important respects: While the text and squence of the biographies were in the main unchanged, the birds were given their modern names, Western species were omitted, the descriptions of species were rewritten, a paragraph was added giving the geographic range as at present known, and additional species were included so as to embrace all the birds now known from the eastern United States and Canada. In all cases, the additional matter was printed in different type from the body of the work, so that Nuttall's original text was clearly set off from the matter contributed by the editor. The title page was misleading, as it failed to indicate the fact that the Western species had been left out, but in the new edition (1896) this is corrected, the new title page reading: 'A Popular Handbook of the Ornithology of Eastern North America.' The book is printed from the same plates as the previous edition, but corrections and additions have been made in the matter contributed by the editor. It is illustrated by text figures and colored plates. The latter might better have been omitted, although it is true that the majority of them may be recognized if looked at through a veil or smoked glass to deaden the unnaturally brilliant colors so characteristic of cheap chromolithographs. It is only fair to the author to state that he is in no way responsible for these plates; they were introduced by the publishers against his desire. The text figures are much better. They are of two kinds: (1) cuts borrowed from Baird, Brewer and Ridgway's History of North American Birds and mostly of high excellence; and (2) figures drawn for the book and mostly unsatisfactory. The latter have a coarse look and evidently were intended for greater reduction; they suffer by contrast with the more finished drawings among which they are scattered.

Mr. Chamberlain has done a public service in enabling the younger generation of bird students to add this classic to their libraries. This will be especially appreciated by those who care more for a bird in the bush than a bird in the hand—who love birds for what they are and what they do in life—for Nuttall's biographies possess a freshness and charm which time can never efface. C. H. M.

The Cell. Outlines of General Anatomy and Physiology. By DR. OSCAR HERTWIG. Translated by M. CAMPBELL and edited by H. J. CAMPBELL, M. D. London, Swan, Sonnenschein & Co.; New York, Macmillan & Co. 1895. 8vo., cloth, 368 pp., 168 figs. $3.00.

The Cell in Development and Inheritance. By Edmund B. Wilson, Ph. D., Professor of Invertebrate Zoology, Columbia University. New York and London, Macmillan. 1896. 8vo, cloth, 371 pp., 142 figs. $3.00.

These two recent books on the same subject by well known investigators, the one in Germany, the other in America, serve to mark a new stage in the differentiation of the biological sciences—the separation of cytology from histology as an independent science. Although, as their titles indicate, they attempt to cover much the same ground, they show a marked dissimilarity in several respects—a dissimilarity which it is worth while to emphasize.

First, however, a word as to the common ground covered. Both consider especially the structure and chemical composition of cytoplasm and nucleus, the phenomena of cell-division, the germ cells in their development and union, and the theories of inheritance from the cytological standpoint. Both works give full bibliographical references.

The most important difference between them arises from the fact that Wilson's work was written three and a-half years after Hertwig's. Wilson is thus able to use the results of the extraordinary activity in cytological research which has characterized the last third of a decade. Aside from this, the standpoint of the authors is slightly different, for Hertwig devotes nearly a third of his book to the results of experimental physiological study on the cell, while these are only incidentally considered by Wilson. Thus only in Hertwig's book do we find a systematic discussion of protoplasmic movement and the phenomena of irritability, metabolism and formative activity. Wilson, on the other hand, discusses more fully certain matters of recent observational study, such as the origin of the tetrads and reduction of the chromosomes. Thus while the scope of Hertwig's work is broader, Wilson's is more recent and more thorough as concerns cell morphology.

The general method of presentation of the subject in Wilson's work is in the highest degree pleasing. It retains the impress of its origin in a semi-popular course of lectures, which makes it easy reading, while the style is clear and interesting—qualities too rarely found in technical works. Each topic is usually begun with a general outline of our present knowledge of the matter, and this is followed by a more detailed and critical presentation of the facts. The historical method of developing the subject is not usually adopted, for this does not lend itself well to the needs of a text-book on a descriptive science.

Hertwig, on the other hand, has a rather heavy, colorless style, and in the translation all of the faults of the original are exaggerated. Indeed, the work has suffered terribly in the attempt to dress it in a new language. An example or two must be given. Thus Hertwig says, very truly, that the latent properties of the cell which become evident only during development "nennt man [in Germany] Anlagen." What, on the other hand, will be the astonishment of the cytological reader of the translation to learn (page 335) that [presumably by the English-speaking cytologists] they are called *fundamental constituent attributes!* In other places the translator appears as ignorant of German as of biology. Thus in one place Hertwig says: "Eine tiefere Bedeutung gewannen diese Thatsachen aber erst, als am Ende des 18. Jahrhunderts sich eine mehr philosophische Betrachtungsweise der Natur Bahn brach." This might be translated thus: These facts [of the cell] did not acquire a deeper significance, however, until the end of the eighteenth century, when a more philosophical manner of regarding nature began to predominate. The translator makes it read (page 2): "Much greater importance, however, was attached to these facts after the investigations, which were carried on in a more philosophical spirit by Bahn [!] towards the end of the eighteenth century, were published." It is unnecessary to state that the philosophic 'Bahn' does not figure in Engelmann's Bibliotheca. Numerous other instances might be given of sentences in which the original meaning is wholly distorted and which are even, in themselves, meaningless, and scores of others in which the greatest liberties have been taken with the original, causing the author to say what he certainly would have avoided saying. The translation is, on the whole, wretchedly done, and bad and

good are so intermingled that the uninitiated reader cannot know what is reliable and what is false.

While Wilson's book leaves little to be desired in respect to careful statement, there is one ground for serious regret, namely, the omission of reference to certain important American papers. We may excuse this in a foreigner, but not in an author in Prof. Wilson's position. Thus, Kofoid's papers upon cleavage in Limax are not referred to in the whole book, yet he first called attention to the failure of Balfour's law referred to on page 273. Also his contributions to the laws of spiral cleavage are of the first importance.

A comparison of the press work of the two books reveals as great a difference as the matter. For in the translation of Hertwig the type is small and worn and the numerous half-tone reproductions are frequently muddy—like the translation. On the other hand, the type in Wilson's book is beautifully clear and the figures, which are nearly all new to text-books, are all that could be desired. The work is indeed a model in the beauty of its illustrations.

While it is impossible to summarize such a book as Wilson's, yet a few of its salient features and conclusions on debated questions may be mentioned. Especially noteworthy are the Table showing the number of chromosomes in germ and somatic nuclei of various animals, and the Glossary, which gives the authors and dates of introduction of each term. Although treating fully Bütschli's view of the honeycomb structure of protoplasm, the author believes (page 19) that the fibrillar structure is the more typical. All the organs of cell-division—centrosome, spindle and chromosomes—are to be regarded as differentiations of the primitive nuclear structure (page 67). His conclusions concerning the factors determining development are clearly stated on page 323 as follows: "Development may thus be conceived as a progressive transformation of the egg-substance primarily incited by the nucleus, first manifesting itself by specific changes in the cytoplasm, but sooner or later involving in some measure the nuclear substance itself. * * * Cell-division is an accompaniment, but not a direct cause of differentiation. The cell is no more than a particular area of the germinal substance comprising a certain quantity of cytoplasm and a mass of idioplasm in its nucleus." These quotations may serve to show that the book is written on broad lines. It certainly takes rank at once among the most important biological works of the period, and it is a book of which its publishers and all Americans may well be proud.

C. B. DAVENPORT.
HARVARD UNIVERSITY.

Physiological Papers. By H. NEWELL MARTIN. Dr. Sci., University of London; A. M., University of Cambridge; M. B., London University; M. D. (Hon.), University of Georgia; late Fellow and Lecturer in Christ College, Cambridge; Fellow of University College, London; Fellow of the Royal Society; Professor of Biology, Director of the Biological Laboratory and Editor of the Studies from the Biological Laboratory, Johns Hopkins University, 1876–1894, and Professor of Physiology in the Medical Faculty of the same. Memoirs from the Biological Laboratory of the Johns Hopkins University III. Baltimore, The Johns Hopkins Press. 1895.

The book before us is intended to commemorate the connection of Prof. Newell Martin with the Johns Hopkins University. In it are reprinted his physiological papers published from the Biological Laboratory created by him there, and some of the public addresses delivered by him on various occasions in this country. The whole forms a handsome quarto volume, valuable not only from its commemorative significance, but also as uniting conveniently for study and reference a series of important and interesting contributions to medical and biological science.

From the physiological point of view, especially at the present time when the investigation of the isolated mammalian heart is being actively renewed, most interest attaches to the papers in which Prof. Martin described the evolution of what he himself termed the Baltimore method for the isolation of the mammalian heart, and many of the most important results obtained with it. The mutual influence exercised on one another by the dif-

ferent parts of the mechanism by which the mammalian circulation is carried on, and the functional connection of all of these by means of the nervous system with all the other organs of the body, often render difficult, sometimes impossible, the drawing of reliable conclusions as to the direct effect of any agency on the heart itself from experiments on the whole organism. Here, therefore, was especially a case for the application of the physiological method of isolation: the separation of a given organ from all its functional, if not anatomical, connections; and keeping it alive, in spite of this separation, by the artificial maintenance of the necessary conditions of continued vital activity in the case of warm-blooded animals—a suitable temperature and a sufficient and constant supply of arterial blood. With an organ thus isolated the determination of the *direct* influence upon it of various factors can relatively easily be certainly determined.

The isolation of the mammalian heart, which Carl Ludwig and Alexander Schmidt had found impossible in 1868, was first accomplished by Newell Martin in 1881. In order to secure arterialization of the blood sustaining the nutrition of the heart, the lungs, rhythmical inflation of which was artificially kept up, were left in functional connection with it. The remaining organs of the body, deprived of their normal blood supply soon die, the heart, however, continuing to beat in a perfectly normal manner for so long as five hours and more, although deprived of all influence of the central nervous system. The pressure under which venous blood flows into its right side can be varied by changing the height of the reservoir containing this, as can also be the pressure under which the left ventricle empties itself by alterations in the height of the outlet connected with it.

With the aid of this method, modified in details as circumstances required, various important fundamental questions in the physiology of the mammalian heart were attacked and solved in the Baltimore laboratory. Most of the communications describing the results of these researches are contained in the present volume, Prof. Martin having been author or joint author of them.

Their titles are: 'A New Method of Studying the Mammalian Heart;' 'The Influence upon the Pulse Rate of Variations of Arterial Pressure, of Veinous Pressure, and of Temperature;' 'Observations on the Direct Influence of Variations of Arterial Pressure upon the Rate of Beat of the Mammalian Heart;' 'The Direct Influence of Gradual Variations of Temperature upon the Rate of Beat of the Dog's Heart' (this formed the Croonian Lecture of the Royal Society for 1883); 'The Action of Ethyl Alcohol upon the Dog's Heart;' 'Experiments in Regard to the Supposed Suction Pump Action of the Mammalian Heart,' and 'On the Temperature Limits of the Vitality of the Mammalian Heart.' It is of distinct historical importance that in this last investigation, in which E. C. Applegarth took part, it was found possible to isolate the heart and keep it alive independently of the lungs, the blood being aerated simply by air bubbling through it. The recent work of Langendorff in Rostock on the isolation of the cat's heart without the aid of the lungs was thus essentially anticipated.

The other original investigations described in the volume are mostly concerned with the respiration. They include Martin's elaborate research on of the respiratory movements of the frog and their nervous mechanism, and the study of 'The Influence of Stimulation of the Mid-Brain upon the Respiratory Rhythm of the Mammal,' in which W. D. Booker was collaborator, the results obtained being later confirmed by Christiani in Berlin. Martin's valuable contribution to the question whether the internal intercostal muscles are to be regarded as inspiratory or expiratory in function, his decision being in favor of the latter alternative, is, of course, also given.

Those of Newell Martin's public addresses on more or less general subjects included in this volume well deserved to be so. They are all admirably written and are most stimulating reading. Martin was a strenuous advocate of the justifiability of vivisection, and in several of his addresses made most powerful pleas for it. A passage such as the following is perhaps more worth quoting in America at the present time than when it was first written:

"It is not mere physical suffering that we

labor to diminish. We labor to save *life—human life* with all its ties. Were I to see a man tortured with facial neuralgia, and knew that I could relieve him by inflicting equal pain on a dog or horse, I hardly know what my decision would be. I suppose I should decide in favor of the man. But that is not the question which faces our profession in regard to experiments on animals; it is how we may better our knowledge and increase our power to save the life of husband and father—of wife or mother—of the child in whose life the hearts and hopes of its parents are bound.

"Certain of our opponents have their sympathies greatly excited by the occasional cry of a dog enduring pain from pharmacological experiment. Have they listened to the wail of the new-made widow? Some of them use their fiercest invective to calumniate those who have kept animals alive a few days after an experiment, that the causation of disease may be better understood and its prevention made possible. Have they realized the years of penury and misery too often the lot of the orphan? They have not felt personal responsibility for the life of the bread winner, or they would surely say with us, kill a hundred, kill a thousand animals if you have any reasonable hope of thereby preserving to one wife her husband, to one child its mother." (p. 254.)

Since the greater part of the above was written, the unexpected news of Newell Martin's death has come from England Our consolation for the relatively early loss of so brilliant a physiologist can only be that in the time given to him for scientific work he obeyed his own exhortation at the close of the lecture inaugurating the biological work of the Johns Hopkins University: "Let us, then, each work loyally, earnestly, truthfully, so that when the time comes, as it will come sooner or later, in one way or another, to each of us, to depart hence, we may carry with us a good conscience, and be able to say that in our time no slipshod piece of work ever left the laboratory; that no error we knew of was persisted in; that our only desire was to know the truth. Let us leave a record which, if it perchance contain the history of no great feat in the memory of which our successors will glory, will at least contain not one jot or one tittle of which they can be ashamed."

The isolation of the mammalian heart will always remain one of the triumphs of experimental physiology. F. S. LOCKE.

HARVARD MEDICAL SCHOOL.

Anleitung zur Mikrochemischen Analyse der wichtigsten Organischen Verbindungen. Von H. BEHRENS, Professor an der Polytechnischen Schule zu Delft. Zweites Heft. Leopold Voss, Hamburg und Leipzig. 1896. 106 pp.

The second part of Behrens' text-book of microchemical organic analysis deals with the important fibres: those of woven goods; wool, silk, cotton, linen, hemp, jute and others; and those of paper; the cellular fibres of straw, alfalfa and wood. The microchemical study of these substances with reagents and in polarized light, and methods for examining woven goods and paper, complete the book. It is well printed and illustrated and a complete work in itself. Besides the illustrations in the text, three beautifully colored plates reproduce the appearance of the different fibres in polarized light and when stained with different dyes. It is well to remember that Prof. Behrens is not only an authority on this subject, but is the only authority for the student, as he has written the only text-books. The organic analysis is a worthy continuation of the author's inorganic analysis.

E. R.

SOCIETIES AND ACADEMIES.

CHEMICAL SOCIETY OF WASHINGTON.

THE 91st meeting of the Society was held Thursday evening, December 10, 1896. The President, Dr. de Schweinitz was in the chair, with thirty members and several guests present.

The first paper of the evening was by Prof. H. W. Wiley on 'The Mechanical Analyses of Phosphatic Slags.'

The second paper was by Prof. Charles E. Munroe, entitled 'An Early Specimen of Gun Cotton.' Prof. Munroe called attention to a sample of gun cotton which he had received from Dr. W. A. Hedrick, some two years ago, and which had been for many years

in the possession of Dr. B. S. Hedrick, formerly Examiner in the U. S. Patent Office. The specimen was in the form of a cartridge, consisting of long staple gun cotton, and although the paper was torn somewhat it was still possible to read that it was labeled 'cotton for shooting,' and that it was made by 'Lennig, of Philadelphia, under patent of October 6, 1846.'

The gun cotton is in a complete state of preservation and, as it apparently dates from shortly after Schoenbein's patent was filed, it is probably the oldest specimen in this country and shows that properly made gun cotton is a stable product. Prof. Munroe then offered in the same connection a copy of Schoenbein's original United States patent, and discussed his claim to being the original discoverer of gun cotton, holding that although he had much improved the process of manufacture, and made it practicable, that Braconot Pelouze and Dumas, had all preceded him in producing an explosive, cellulose nitrate. There was some discussion, especially as to a discrepancy between the dates of the patent and that on the specimen presented by Prof. Munroe.

Dr. W. J. Hedrick referred to the connection of his father with the Patent Office, and said that formerly the laboratory of the Agricultural Department, which was then under the Interior Department, was connected with the Patent Office, and that the specimen might have come from this laboratory. Dr. Littlewood said that he had tried to obtain further data, but had found no explosives in the office as old as this specimen. He further stated that few would be handed down by him to his successor, as his policy was to remove all explosives as soon as possible. Mr. Dewey said that he would not put much faith in the date on the specimen. Lennig may have made a mistake in the date. He was sceptical as to its age. Prof. Munroe said that if it dated back only to 1860 it was old. After further discussion by Dr. Fireman and Prof. Munroe, Mr. W. D. Bigelow gave a description of a 'Convenient Apparatus for the Estimation of Urea in Urine by the Hypobromite Method.' The apparatus consisted of a burette so bent that the graduated part forms the arc of a circle, the center of which is a lip at the end farthest from the stop cock. Above the stop cock is a thistle-tube top for the introduction of the reagents.

A. C. Peale,
Secretary.

Texas Academy of Science.

The mid-year meeting of the Texas Academy of Science was held in San Antonio, December 31, 1896.

At the afternoon session the following papers were read: 'Notes on the Physiology of the Central Nervous System of some of the Lower Amimals,' by W. W. Norman, professor of biology in the University of Texas. 'The Evolution of Culture,' by Thomas Fitzhugh, professor of Latin, University of Texas. 'Vertical Curves for Railways,' by J. C. Nagle, professor of engineering, Agricultural and Mechanical College of Texas. 'Notes on Indian Corn and some of its Uses Among Modern and Ancient Mexicans,' by Dr. David Cerna, Medical Department of the University of Texas.

The chief event of the evening session was the address of Maj. C. E. Dutton, U. S. A., on 'The Economics of Concentrated Capital.' Dr. George Bruce Halsted, President of the Academy, also spoke briefly on 'The Greatest Foundling House of the World, a Personal Study in Russian Sociology.'

Dr. Cerna had the pleasure of presenting to the Academy, Mrs. Frances Long Taylor, a daughter of Dr. Crawford W. Long, of Georgia, the well known discoverer of the anæsthetic properties of ether.

At the close of the meeting the members of the Academy were entertained by Major Dutton at his residence.

Frederic W. Simonds.

NEW BOOKS.

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CONTENTS:

Chemistry in the United States: F. W. CLARKE....117
The American Physiological Society: FREDERIC S. LEE....129
Electrification of Air by Röntgen Rays: LORD KELVIN, J. G. BEATTIE, M. SMOLUCHOWSKI DE SMOLAN....139
Current Notes on Anthropology:—
Origin of Rock Paintings; The Meaning of Mourning; Primitive Travel and Transportation: D. G. BRINTON....141
Scientific Notes and News:—
Modern Army Rifles; General....142
University and Educational News....146
Discussion and Correspondence:—
A National Department of Science: WASHINGTONIAN. *The Jurassic Wealden (Tithonian) of England:* JULES MARCOU. *Compliment or Plagiarism:* GEORGE BRUCE HALSTED. *A Meteorological Conference at Paris:* A. LAWRENCE ROTCH. *The Study of Fear:* WESLEY MILLS. *Glossophaga truei:* HARRISON ALLEN....147
Scientific Literature:—
Dwelshauvers-Dery's Étude de Huit Essais de Machine à Vapeur: R. H. THURSTON. *Hutchinson on Prehistoric Man and Beast:* D. G. BRINTON. *Hart's Chemistry for Beginners.* JAS. LEWIS HOWE. *Lassar Cohn on Die Chemie im Täglichen Leben:* W. R. O....153
Scientific Journals:—
The American Chemical Journal: J. ELLIOTT GILPIN....157
Societies and Academies:—
Nebraska Academy of Sciences: G. D. SWEZEY. *Biological Society of Washington:* F. A. LUCAS. *The Academy of Science of St. Louis:* WILLIAM TRELEASE. *Northwestern University Science Club:* A. R. CROOK. *University of Wisconsin Science Club:* WM. S. MARSHALL....158

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*CHEMISTRY IN THE UNITED STATES.**

IN the history of science, from whatever point of view we may consider it, the several branches develop according to a natural order. The more obvious things attract attention first; the less obvious are recognized later. Plants, animals, stones and stars are studied even by savages; but the hidden forces of nature, governed by laws which can be utilized for man's benefit, escape discovery until civilization is far advanced, and even then are revealed but slowly. At first each department of knowledge is purely empirical, a mass of facts without philosophical connection; but sooner or later speculation begins, the scattered evidence is generalized, and an organized science is born. The study of concrete facts, the recognition of our surroundings, precedes the study of relations.

Among the sciences, chemistry is one of the youngest. As an organized branch of systematic knowledge it has little more than completed its first century. Before the time of Robert Boyle it was hardly better than empiricism. At first a few scattered facts were recognized, involving transformations of matter. Some of these were applied in the arts, as in metallurgy and in medicine; and their generalization led simply and naturally into alchemy, with its search for the philosopher's stone, the uni-

* Presidential address, Philosophical Society, Washington, December 12, 1896.

versal solvent and the elixir of life. There was no chemistry in the modern sense of the term, but only a group of visionary speculations which foredoomed their devotees to failure. In these failures, however, truth revealed herself, discoveries were made other than those which were expected, and the foundations of a new science were laid. It was more than forty years after the landing of the Pilgrims at Plymouth when Boyle announced the true definition of a chemical element, and the discovery of oxygen was not made until over a century later. The history of modern chemistry and the history of the United States begin at nearly the same time.

In America, as in the world at large, the development of science followed along the natural lines. A new country had no time for abstractions, such as chemical studies were in the early days, and only the more obvious branches of investigation received much notice. Botany and zoology flourished to some extent, and even mineralogy had able students; for the resources of an unexplored continent could not be ignored. Astronomy, too, was somewhat cultivated, but because of its usefulness in the measurement of time and navigation, rather than for its interest as an intellectual pursuit. The practical side of science was necessarily and properly foremost; and this fact is nowhere more apparent than in the physical researches of men like Franklin and Rumford. The obvious and useful came first; philosophy, theory, might wait until men had more leisure. So, while chemical discoveries were rapidly multiplied in Europe, little advancement could be recognized here. Even that little was utilitarian, and chemistry in this country was first brought into general notice through its relations to medicine and pharmacy, and through the agency of medical schools.

Prior to the year 1769 chemistry had no independent existence in the work of American colleges. It was taught, if indeed it was taught at all, only as a subordinate branch of natural philosophy. But in the year just named, Dr. Benjamin Rush was appointed to a chair of chemistry in the medical department of the University of Pennsylvania—an event which marks the first recognition of the science in the United States by any institution of learning. Other medical schools soon followed the example thus set, and chemistry took its place as a regular subject for study. Rush, however, was not specifically a chemist; he had, indeed, been a pupil of Black, in Edinburgh; but he carried out no chemical investigations and added nothing to the sum of chemical knowledge. His high reputation was won in other fields; but as the first professor of chemistry in America he occupies a historical position.

In 1795 the trustees of Nassau Hall, now Princeton University, elected Dr. John Maclean professor of chemistry. Other colleges soon followed the lead of Princeton, and within a very few years chemical science was well established as a distinct branch of study in many American institutions. The teaching, however, was wholly by text-books and lectures, the laboratory method was unknown, and the teacher commonly divided his attention between chemistry and other themes. There were professors of chemistry and natural philosophy, of chemistry and natural history, but rarely, if ever, professors of chemistry alone. Moreover, little time was given to the subject; the classics and mathematics overshadowed all other studies, and the pupil learned hardly more than a few scattered facts and the barest outline of chemical theory. When we note that to-day Harvard University employs twenty-two persons, professors, assistant professors, instructors and assistants in chemistry alone, we begin to realize the great advance which

has been made in the teaching of science since the days of Maclean, Hare and the elder Silliman.

In 1794 Joseph Priestley, the famous discoverer of oxygen, driven from his English home by religious persecution, sought refuge in America. He took up his abode at Northumberland, in Pennsylvania, where he died in 1804, and where his remains lie buried. His coming greatly stimulated the growing interest in chemistry upon this side of the Atlantic, for Priestley entered at once upon close relations with many American scholars, and took an active part in the work of the American Philosophical Society at Philadelphia. At Northumberland he completed his discovery of carbon monoxide, and made some of the earliest experiments upon gaseous diffusion; but unfortunately much of his time was devoted to theory, and to defending against the attacks of Lavoisier's followers, the moribund doctrine of phlogiston. Priestley's discovery of oxygen was the corner stone of chemical science; but the discoverer, great as an experimentalist, was not successful as a philosopher, and he never realized the logical consequences of his achievement. To the day of his death he opposed the new chemical philosophy and clung to the obsolete ideas of an earlier generation.

During the first quarter of the present century the progress of chemistry in the United States was slow. It is not my purpose to discuss in this address the details of its advancement, for that work has already been exhaustively done by another;* still several events happened which deserve notice here. First, Robert Hare, in 1802, invented the oxyhydrogen blowpipe. With that instrument, in following years, he succeeded in fusing platinum, silica and about thirty other refractory substances which had hitherto resisted all attempts at liquefaction. But few men have given a greater extension to our experimental resources. The calcium light and the metallurgy of platinum are among the direct consequences of Dr. Hare's invention. Secondly, in 1808 Professors Silliman and Kingsley, of Yale College, published their account of the meteorite which fell at Weston, Connecticut, the year previous. This paper attracted widespread attention, and drew from Thomas Jefferson the oft-quoted remark "that it was easier to believe that two Yankee professors could lie than to admit that stones could fall from heaven." The analysis of the meteorite was the work of Silliman, and was among the earliest of its kind. It was done with appliances such as a modern high school would despise, and without the aid of any manual of analytical chemistry; and its merit is due partly to the fact that it was well done, and partly to the way in which great difficulties were overcome. In weighing the work of the early investigators we must remember that they lacked the resources which are so easily commanded nowadays, and that the methods of research had not been reduced to system. Their success was in spite of disadvantages which would baffle most men; there was less encouragement than now in the way of popular applause, and their efforts are therefore all the more praiseworthy. To-day scientific investigation is an established art, its ways are well worn and well trodden; and, although the highest achievements are as difficult of attainment as ever, even a beginner may hope to accomplish something.

During these early years much attention was paid by American chemists to the study of minerals, for rich new fields were open; and in 1810 Archibald Bruce began the publication of *The American Minerological Journal*, of which four numbers were issued.

*Benjamin Sillman, Jr. 'American contributions to Chemistry.' American Chemist, August, September and December, 1874. An address at the 'Centennial of Chemistry.'

This was probably the first attempt to publish in this country a magazine devoted entirely to science and supported wholly by native contributions. As early as 1811 there was a Columbian Chemical Society in Philadelphia, and in 1813 a volume of its 'Memoirs' appeared. In 1817 the *Journal of the Academy of Natural Sciences of Philadelphia* was started; and the next year saw the birth of Silliman's *American Journal of Science*. The last named periodical, a classic among scientific serials, was for sixty years the chief organ of American chemistry; and even yet, despite the rivalry of more specialized journals, it contains a fair proportion of chemical contributions. The first American to publish a systematic treatise on chemistry was Prof. John Gorham, of Harvard College, whose 'Elements of Chemical Science,' in two octavo volumes, appeared in 1819. The work was well received and was an excellent one for its day.

The period from 1820 to the outbreak of the Civil War was one of steady progress in America, both as regards scientific research and in the development of institutions. Colleges were founded, societies were organized, there were better facilities for work, and the general appreciation of science became greater. But, for the reasons which were stated at the beginning of this address, the so-called natural sciences rather took the lead, and there was more activity among geologists and zoologists than in the field of chemistry. Many States organized surveys; the general government sent out exploring expeditions; and so geology and natural history received a patronage in which chemistry had little or no share. The chemists were mainly dependent upon their own resources, and got along as best they could. Still, their number increased, their published investigations became more numerous, and their services were in greater demand, both commercially and in the work of instruction.

At first the would-be chemist had to make his own pathway. Chemistry was taught in the colleges, not as a profession to be followed, but as a minor item in that ill-defined agglomeration of knowledge which in those days was called 'a liberal education.' In 1824, however, the Rensselaer Polytechnic Institute, at Troy, was founded, and a new era in scientific education began. In 1836 Dr. James C. Booth opened a laboratory in Philadelphia for instruction in practical and analytical chemistry, and in 1838 Prof. Charles T. Jackson did the same thing in Boston. Chemistry could now be studied in something like a systematic manner, but the students who were able to do so went abroad, at first to London, Edinburgh and Paris, and later to the famous laboratory of Liebig in Germany. The impulse toward foreign study continues to our own day; even though American facilities have increased enormously, and a good chemical training can now be obtained at home.

The decade from 1840 to 1850 was a period of great advancement in American Science, and several events of the utmost importance occurred. In 1829 James Smithson, an Englishmen, bequeathed his property to the United States, to found in Washington 'an institution for the increase and diffusion of knowledge among men;' and in 1846 his project was realized. The Smithsonian Institution was established, and under the direction of Joseph Henry it became at once a center of scientific influence and activity. Smithson, it will be remembered, was a chemist and mineralogist, and it was, therefore, eminently proper that the Institution which bore his name should, from the very beginning, maintain a chemical laboratory. Furthermore, in the earlier years of its history, the Institution provided courses of popular lectures upon chemistry; it has subsidized some chemical investigations, has published original researches,

and it has issued a number of useful works in the way of special reports, volumes of physical constants and bibliographies. Although its energies have been more conspicuously exerted in the fields of zoology, anthropology and meteorology, it has done much for chemical science; the subjects which interested its founder have never been neglected. In the history of American chemistry the Smithsonian Institution plays an honorable part.

In 1847 and 1848 the Sheffield and Lawrence Scientific Schools were founded, the one at New Haven, the other under the protecting shelter of Harvard College. In the one, chemistry was taught by J. P. Norton and the younger Silliman; while Horsford conducted the laboratory at Cambridge. The much older Polytechnic Institute at Troy had developed mainly as a school of engineering, so that the two new institutions practically stood by themselves, as the only higher schools of chemistry—schools in which professional chemists could receive a thorough training—within the limits of the United States. Their influence soon began to be felt, their graduates went forth to take important positions, the stimulus to scientific studies spread to the colleges, and the chemist became recognized as the representative of a new learned profession. Law, medicine and divinity no longer formed a class by themselves; other branches of scholarship were to take rank with them.

In 1846 Agassiz came to America, bringing with him the research method as a method of education. Himself a zoologist, his influence as a teacher was evident in all directions, and chemistry shared in the new impulse. There were many pupils of Liebig and Wöhler in the United States, men well imbued with the spirit of the new education; and to them the coming of Agassiz was a reinforcement and an inspiration. The old college curriculum was compelled to expand, and the true conception of a university began to be recognized on this side of the Atlantic. In 1848 the American Association for the Advancement of Science was organized, and science received a national standing which the local academies and societies could never have given it. The influence of the Association upon chemistry will be considered later.

In 1850 Josiah P. Cooke was elected professor of chemistry in Harvard College. He had received his bachelor's degree only two years earlier, but during his student days no chemistry had been taught to the Harvard undergraduates. Practically self-taught, and largely through the medium of experiments, he realized the value of the laboratory method of instruction and, in spite of conservative opposition, he set to work to bring about its adoption. He was allowed at first the use of one basement room for his purposes, but was compelled to pay all or nearly all of the laboratory expenses out of his own pocket, for the college funds could not be wasted on strange innovations, and the recitation method still reigned supreme. Prof. Cooke, however, understood how to be patient and persistent at the same time; year by year his courses of study were extended, by slow degrees his resources increased, and in 1858 Boyleton Hall, the present laboratory building, was completed. At first, part of the building only was assigned to chemistry; now all of it is devoted to the teaching of that science. It is truly a monument to Prof. Cooke, whose energy and persistence caused it to be erected, and to whom, more than to any other one man, the full recognition of the laboratory method in American colleges is due. The initiative was taken by the scientific schools, but the colleges were compelled to follow; and to-day even the high schools, the feeders of the colleges, have their chemical laboratories in which elementary practice and qualita-

tive analysis are taught. Chemistry is now seen to be one of the best disciplinary studies, and it fails in educational value only when the teaching of it is entrusted to improperly trained pedagogues of the obsolete text-book school. The teacher who is a slave of text-books is as bad as no teacher at all. To teach chemistry one must think chemistry; a mere memory for facts is not a sufficient qualification.

Leaving out of consideration the names of many American chemists who published important researches during this period of our history, for personal details would not be in place here, we come down to the date of the Civil War, which marks an epoch in more senses than one. In science, as well as in politics, the war divides American history into two periods—the one a period of preparation and slow growth, the other a period of swift advances and fruition. Through the war the Nation had received a sharp stimulus, and the re-establishment of peace was followed by wonderful progress in many directions. Population and wealth increased with great rapidity, and in due time that wealth began to flow into educational channels. The Nation itself embarked in many new enterprises; these demanded the aid of science, and so the latter received encouragement which its students had hardly dreamed of before. Even during the war the land-grant college bill was passed by Congress, and soon every State was provided with new facilities for scientific instruction, and the demand for trained teachers was greatly increased. The foundation of Cornell University, which opened its doors to students in 1868, was one of the consequences of this bill. In 1864 the School of Mines of Columbia College began its work; in 1865 the Massachusetts Institute of Technology was started; and these were followed by the Polytechnic School at Worcester in 1868, and the Stevens Institute at Hoboken in 1870. Even the older schools of science developed more rapidly, and in the Lawrence Scientific School particularly the research method of instruction was pushed into great prominence by Wolcott Gibbs. Hitherto our professors of chemistry had been commonly content with teaching what was already known, but under Gibbs the student was taught to think and to discover. Training in the art of solving unsolved problems became a part of the school curriculum. This phase of chemical education was brought into still greater prominence some years later, in the laboratory of the Johns Hopkins University, and now it is well nigh universal. Original research, once an occasional feature of American college work, is now emphasized in all of our better universities, and the student's thesis outweighs his examinations in importance. At first, as was but natural, our educational system was modeled after that of England, with Oxford and Cambridge as the shining examples to follow. Here, as there, the passing of examinations was the one supreme test of scholarship; but the growth of science in Germany attracted our better students thither, and they returned full of the modern doctrines. The German graft upon our English stock has made our universities what they are to-day, and now the man who can increase knowledge is more highly esteemed than him who merely knows. The knowledge which is fruitful outranks the sterile culture whose end is in itself. In all departments of learning, education has become more vital, more of a living force; and in this great movement forward the chemist has been a leader and a pioneer.

For many, many years the chemists of America were unorganized, a thousand scattered units, each doing what he could as an individual, but with no bond of union other than that of common interest. Here and there chemical societies were founded,

to last for a year or two and then perish for lack of proper support. They were local experiments, nothing more; and no list of them could be made. In the more general societies, like the American Academy in Boston and the Academy of Natural Sciences in Philadelphia, the chemists had a part, but it was one of minor importance—an item among many.

In the American Association for the Advancement of Science there were some chemists who attended the meetings from time to time, and occasionally presented papers. They were overshadowed, however, by the more active representatives of other sciences, and their share in the proceedings was rarely conspicuous. The Association was divided, at the time of which I speak, into two sections—A and B, and in the first of these chemistry, physics, mathematics and astronomy were crowded together, with chemistry the least prominent of all.

In 1873 the Association met at Portland; and a handful of chemists, most of them young and unknown, but enthusiastic, were present. The time was ripe for a step forward, and that step, a very short one, was taken. The Association was requested to allow the formation of a sub-section of chemistry; a year later, at Hartford, the request was granted, and the sub-section began its career.

Some two weeks before the meeting at Hartford, on August 1, 1874, about seventy-five chemists met at Northumberland, in Pennsylvania, to celebrate, at the grave of Priestley, the centennial of the discovery of oxygen. It was now proposed to organize an American Chemical Society, modelled after the already flourishing societies of London, Paris and Berlin; but action was deferred, in order that the new experiment in the American Association might have a fair trial, and that the danger of undue competition, with its attendant division of forces, might be avoided. The new sub-section received general support, it grew and flourished; and when, in 1881, the American Association was reorganized, it became the full Section C of the present body. To-day the chemical section is one of the strongest and most vigorous in the Association, with a large and faithful membership which has been built up in great measure by the efforts of the men who started it twenty-three years ago.

In 1876 the project for an American Chemical Society was revived, and an organization bearing that name was established in New York. It obtained a fair membership and published a journal; but as all the meetings were held in one city it did not command the support of the country at large, and it became essentially a local body in spite of its claims to national scope. It was national in theory, and also in purpose, but it failed to receive general recognition; and it exerted no wide-spread influence until, after sixteen years of existence, it became a potent factor in the development of a larger enterprise.

In 1884 the Chemical Society of Washinton was formed. This was professedly local in its character, and so too were several other bodies of chemists which were organized within a year or two of this time. There was no concentration of effort among the chemists of America, except in the American Association, and that, unfortunately, met but once a year. There were nuclei enough, however, for crystallization to begin, and in 1888 another step was taken. The chemical section of the American Association appointed a committee to confer with like committees from other societies, and to report upon the question of a national organization. Conference after conference was held; report after report was presented; there was opposition, of course, from various quarters, and indifference to be overcome; there were conflicts

of interest and the inevitable rivalries. But the movement was started; it was finally endorsed in due form by the old chemical section, and in time success was won. In 1891 and 1892 a plan was agreed upon, and the present American Chemical Society was established.

The two principal factors in the problem, apart from the American Association, were the American Chemical Society in New York and the Chemical Society of Washington. The former had the name and a charter, and, with some reason, claimed to occupy the field. The other made no claims, but would not concede primacy to the first. Professional interests and good feeling, however, carried the day; there were concessions from all sides, and the following plan was adopted: The existing name and charter were accepted. The New York body became a local section of the reorganized Society, and the Washington organization did the same. The old journal of the Society was consolidated with the flourishing *Journal of Analytical and Applied Chemistry*, with the editor of the latter, Prof. Hart, in charge. Other local sections were provided for, and it was agreed that the Society should hold two general meetings a year—one in winter, the other in coöperation with the American Association. Thus all interests were reconciled, and the scattered forces of the chemists began to converge toward a single point. A strong Society was created, with a good monthly journal; and to-day it numbers over a thousand members, with nine local sections in various parts of the country, carrying on continuous work. Hereafter the summer meeting will be held jointly with that of Section C in the American Association, making both bodies stronger and more efficient; all opposition has been overcome, the membership of the Society is rapidly growing, and the future seems bright. The example which has been set by the chemists may be a good one for others to follow. "In union there is strength." In New York there is also a section of the British 'Society for Chemical Industry;' and, in addition to the journal already mentioned, there is the well-established *American Chemical Journal*, managed by Prof. Remsen, at Baltimore, and a new periodical devoted to physical chemistry, which has just been started by Professors Trevor and Bancroft, at Cornell University. Our chemists are now well provided with means for publication, and there seems to be no dearth of material with which to fill the pages of the three separate journals. The *American Journal of Science*, the 'proceedings' of some local academies, and the foreign chemical periodicals also receive a share of our output. The facilities for publication seem to increase no faster than the activity of the American chemists.

On the purely scientific side the government of the United States has as yet done little for the advancement of chemical research. But indirectly, for economic reasons, it has done much, especially since 1876. So, too, have the governments of various States and cities, especially with regard to the analysis of fertilizers, and in the direction of sanitary chemistry. Some investigations concerning the water supply of cities have been carried out by local Boards of Health, and among these the researches instituted by the Massachusetts Board have been of the highest scientific quality. No better work of its kind has been done anywhere; and its results, intended for local benefit, are of far more than local value. On the part of the general government the patronage of chemistry has covered a wider range, and many bureaux have been provided with laboratories. In the Department of Agriculture a considerable force of chemists has long been employed, dealing with questions of the most varied character. The United States Geo-

logical Survey maintains another important laboratory, and still others are connected with the Bureau of Internal Revenue, the Mint, the Army and the Navy. In the Torpedo Station at Newport investigations are carried out relative to explosives, and at the custom house in New York a number of chemists are engaged in the valuation of imported articles with reference to the assessment of duties. In short, the government calls upon the chemist for aid in many directions, and the appreciation of his usefulness increases year by year. In all this work, however, chemistry is rated as a convenience only, and valued for what it can give; its advancement as a science is not considered, and such growth as it gains through governmental encouragement is purely incidental. Good researches of a strictly scientific character, real enlargements of scientific knowledge, have come from laboratories maintained by the government; but they represent the rare leisure of the investigator and not the essential object of his work. He is sometimes permitted to investigate for the sake of chemistry alone; but such labor is extra-official, and forms no part of his regular duties. The chemist is compelled to serve other interests, other sciences it may be; and only the time which they fail to demand is his own. Considering the enormous importance of chemical research to all the greater industries of the world, it should receive fuller recognition by the National government, and be encouraged most liberally.

I have already referred to the Land-grant College Act of 1862, under which so many agricultural and technical schools came into existence. In 1887 Congress passed another act, intimately related to the former, by which the States and Territories were each granted the annual sum of fifteen thousand dollars for the maintenance of agricultural experiment stations. These stations, some of which have other resources also, are actively at work, and they receive some coordination under a bureau of the Federal Department of Agriculture. Chemistry receives a part of their attention, and in 1894 one hundred and twenty-four chemists were employed in them. These chemists, and those connected with the Washington laboratory, are bound together in the Association of Official Agricultural Chemists, which meets annually. A prime object of that association is the improvement, definition and standardizing of analytical methods; and along this line it has done admirable work. The data obtained in the different experiment stations are thus rendered strictly comparable, and a higher degree of accuracy is reached than would have been attained under conditions of absolute individualism. The Association fills a distinct place of its own and is in no sense a rival of the American Chemical Society. Indeed, the members of the official body are nearly all members of the other.

In the industrial field, as well as in the domain of pure science, the chemists of the United States have made rapid advances during the past thirty years. In manufacturing chemistry the growth has been only moderate, at least in comparison with the growth of other industries, but still it is evident. We still import heavily, and depend upon Europe for many chemical products which ought to be manufactured here. In some special lines our goods are among the best; in others we are wofully backward. To some extent our tariff and revenue legislation has had a bad effect upon our chemical manufacturers; as, for example, in increasing the cost of alcohol; and certain defects in our methods of scientific teaching have also been to blame. To this subject I shall recur presently. In metallurgical processes the United States can hold its own, however, and especially in those which involve the applications of

electricity. The electrical furnace, for instance, as it is used in the manufacture of aluminum, is distinctly an American invention, and the electrolytic refining of copper is carried out in this country on a scale unknown elsewhere.

If we consider the subject of applied chemistry at all broadly, we shall at once see that it has several distinct aims; such as the discovery of new products, the improvement of processes and the utilization of waste materials. It seeks also to increase the accuracy of methods; to make industrial enterprises more precise, and therefore more certainly fruitful; in short, to replace empiricism by science. It is, perhaps, in this direction that chemistry has made its most notable advances in America, and that within comparatively recent years. Three decades ago, even our greatest manufacturing establishments employed chemists only in a sporadic fashion, sending occasional jobs to private laboratories, and then only after counting the cost most parsimoniously. Except in a few dyehouses and calico printeries, the chemist was not fully appreciated; great losses were often sustained for lack of the services which he could have rendered, and the cost of goods was therefore higher than was necessary. By degrees, however, a change was brought about; one effect of industrial competition was to narrow margins and to render greater accuracy of manipulation imperative; and so the chemist was brought upon the scene. To-day it is almost the universal custom among manufacturers to maintain chemical laboratories in connection with their works; and this is especially true with regard to metallurgical establishments, oil refineries, soap, candle and glass works, in the making of paints, varnishes and chemicals, and so on in many directions. Even the great firms whose industries are connected with the Chicago stockyards, with their artificial refrigeration and their manufacture of lard, lard and butter substitutes, meat extracts, pepsin and fertilizers, all employ skilled chemists and provide well-equipped laboratories. In the making of steel and iron the processes are followed by analyses from start to finish, from ore, fuel and flux to the completed billets; and the chemists who are thus occupied have gained marvellous dexterity. The analytical methods have been reduced to great precision, and are extraordinary as regards speed; work which once required a day to perform being now executed in less than twenty minutes. Exact measurement has replaced rule of thumb; certainty has supplanted probability; industry has become less wasteful and surer of a fair return; and to all this the chemist has been a chief contributor. Without his aid the manufactures of the world could never have been developed to their present magnitude and efficiency. His influence reaches even beyond the furnace or the factory and touches the greatest economic questions. Take, for example, the financial agitation through which our country has so recently passed, with its discussion of monetary ratios. Chemical processes have profoundly modified the metallurgy of gold and silver, cheapening the production of both metals, and changing the commercial ratio of their values. Can the bi-metallic question be intelligently investigated with the chemical factor left out? Furthermore, chemistry has created new industries in which both gold and silver are employed; and so, affecting both supply and demand, touches their ratios still more deeply. When politics becomes true to its definition, when it is really 'the science and art of government,' then we may expect politicians to consider questions like these and to study the evidence which chemistry has to offer.

One other phase of applied chemistry, chiefly developed in this country, remains to be mentioned. In 1875 the Pennsylvania Railroad opened a laboratory at Al-

toona, in charge of Dr. C. B. Dudley; and eight or nine other great railroads have since followed its lead. In these railroad laboratories, which employ many men, all sorts of supplies are tested, and large contracts for purchases depend upon the results of analysis. Among the articles regularly examined, preliminary to buying, are iron, steel, various alloys, paints, varnishes, soaps, wood preservatives, disinfectants, *et cetera*. On the Pennsylvania system alone the purchases controlled by these tests amount to from two to three millions of dollars annually, and the saving to the company is undoubtedly very great. In many cases other purchasers adopt the specifications of the railroad and base their contracts upon the same standards, the analyses to be made in the same way. Adulteration is thus discouraged and prevented, and the moral effect upon the seller, who must be honest, is most salutary. When detection is certain the temptation to commit fraud vanishes. To the improvement of analytical methods the railroad laboratories have contributed materially, so that their work has true scientific significance as well as practical value.

Now, although we may properly take pleasure in the advances which American chemists have made, we have no right as yet to be fully satisfied. We have done much, but others have done more; and until we stand in the front rank we should not slacken our efforts. The competition of research is fully as keen as the competition of trade, and even if we may win the lead we must work hard to keep it. In spite of all that I have said of its growth, industrial chemistry in the United States is still in its infancy, and comparison with other countries is in some respects wholesomely humiliating. England and France have built up chemical industries vastly greater than ours, and in certain directions Germany leads them both. Moreover, the German industries and the trade depending upon them are increasing at a marvelous rate, and in England the chemists at least have taken serious alarm at the growing competition. Branches of manufacturing which were once almost wholly English are now mainly German; discoveries which were made in England have been developed in Germany, and now the British economists are seeking for the reason.

To the chemist the reason is plain, and is to be found by a study of two systems of education. The English universities and schools have clung to obsolete methods, and have attached great importance to examinations and the winning of honors. To the honor men positions and preferment are open, but the honors are awarded in the wrong way. In Germany, on the other hand, the pathway to success lies through research; honors are given to the men who have increased knowledge; and the effect of this policy is felt by every manufacturer upon German soil. Take, for example, the great chemical works at Elberfeld, in which about one hundred scientific chemists are employed in addition to a great force of laborers. Every one of these chemists received a training in research; every one is expected to make discoveries; and the results of their investigations are immediately applied in the manufacture of new preparations and the improvement of processes. The German employer does not ask the chemist to do for him what he can do already, but rather to supply the greater forces by which he can rise above his competitors and command the custom of the world. To that policy we have not yet fully risen in America; our technical schools have thought too much of routine drill and discipline; and until we profit by the example of Germany more thoroughly than we have done we cannot hope to rival her in chemical industries. Our practical men value science for what it can do directly

in their interest, and rarely look deeper into the possibilities of abstract investigation. In reality, pure science and applied science are one at the root; the first renders the second possible, and the latter furnishes incentives for the first. Where science is most encouraged for its own sake there its applications are most speedily realized. This is a lesson which America has yet to learn, at least to the point of full and complete appreciation.

What, now, have we done, and what should we do? We have made a great beginning; we have built up good laboratories, backed by richly endowed institutions of learning; millions of dollars have gone into the teaching of chemistry, and the stream of research flows on with ever-increasing volume. American investigations and investigators are known throughout the civilized world; their creditable standing is fully recognized; our analysts are among the best; and yet—and yet—something is wanting. A great mass of good work has been done, beyond question; but no epoch-making generalization, fundamental to chemistry, has originated in the United States, nor has any brilliant discovery of the first magnitude been made here. The researches of American chemists have been of high quality, but not yet of the highest; there is solidity, thoroughness, originality; but with all that we cannot be satisfied. The field is not exhausted; there are great laws and principles still to be discovered; the statical conceptions of to-day are to be merged in wider dynamical theories; for every student there are opportunities now waiting. Shall we do our share of the great work of the future, or shall it be left to others? Shall we follow as gleaners or lead as pioneers? He who has faith in his own country can answer these questions only in one way.

At present, American chemists labor under some disadvantages which have not been fully out-grown. Research, with most of them, is at best encouraged, but not expected as an important professional duty. The teacher must first teach, and in too many cases the routine of instruction takes all his strength and time. The resources available for education have been scattered by sectarian rivalry; several schools are planted where only one is necessary; and the teachers, duplicating one another's work, and furnished with slender means, cannot specialize. Two chemists dividing the work of one institution can do more than four who labor separately. The field is too large for one man to cover alone, and yet most of our men are expected to do it. This evil, however, is growing less and less, and in time it may cease to operate. With the increase of true post-graduate institutions the work of American chemists will improve, for in that part of the educational domain research is an essential feature. Give our men the best opportunities, the best environment, and they will do their share of the best work.

In one direction, perhaps, the possibility of advancement is greatest, and that is in the institution of laboratories for research. At present the labor of investigation is unorganized, unsystematic, a little here, a little there, but no coördination; and consequently our knowledge is after all a thing of shreds and patches. In making this statement I do not exaggerate. Take any class of scientific data, examine any series of chemical compounds, and note the gaps which exist in it. A chemist in Berlin has studied one of the compounds, another in Paris has prepared a second, many bits of information have been gathered by many individuals, and so knowledge slowly accumulates. The organization of research is to be one of the great works of the future, when discovery shall become a profession, and groups of students shall cooperate to-

ward the attainment of clearly specified ends. To some extent this work has already been done for astronomy, and more than one observatory could exemplify what I mean. In a fully manned and equipped observatory great investigations, too large for one astronomer to handle alone, can be carried out systematically; and this is actually done. In mapping the heavens, even, several observatories can combine their forces, each one covering a definite part of the field; but in chemistry no policy of this kind has yet been possible. The extension of the observatory method to other departments of science is the advance for which I plead.

Suppose now we had a great laboratory, fitted up for chemical and physical work together, well endowed and well manned. What might we not expect from it? Great problems could be taken up in the most thorough and orderly fashion, methods of work might be standardized and groups of physical constants determined; the results would aid and stimulate individual students everywhere, and applied science, too, would receive its share of the benefit. There is to-day a growing commercial demand for accurately determined constants, and no institution in which the demand may be adequately supplied. At Charlottenburg, in Germany, there is a beginning; in London the munificence of Ludwig Mond has made possible a similar start; but nowhere is such a plan as I propose in full and perfect operation. The United States has great observatories, fine museums of natural history and flourishing universities; why should it not have institutions for physics and chemistry also? These sciences touch many industries at many points; their applications have created wealth beyond all possibility of computation; now let that wealth do something for them in return. Half the sum that the Nation spends in building one battleship would erect, equip and endow a laboratory more complete than any now existing, whose influence would be felt throughout all civilized lands and endure as long as humanity. In this the United States might take the lead and set a great example to all other nations. The United States has long been a follower in science; may she soon take a higher place as teacher.

F. W. CLARKE.

U. S. GEOLOGICAL SURVEY.

THE AMERICAN PHYSIOLOGICAL SOCIETY.

THE ninth annual meeting of the American Physiological Society was held in Boston and Cambridge on December 29 and 30, 1896. The sessions of the first day were held at the Harvard Medical School, those of the second day at the University Museum, Cambridge. The following communications were presented and discussed:

Studies in the physiology of the mammalian heart. W. T. PORTER.

Cannulas were placed in the aorta and the innominate and pulmonary arteries of the cat. A thermometer was inserted in the right auricle through the superior vena cava. All other heart vessels were ligated, except the coronary arteries. Warm defibrinated cat's blood flowed into the aorta under pressure, passed through the coronary vessels and escaped, in drops as a rule, from the pulmonary cannula. A mercury manometer connecting with the innominate artery recorded the pressure at the mouths of the the coronary arteries. A Hürthle membrane manometer, coupled with a tube that was passed into the left ventricle through the left auricular appendix, registered the force and frequency of ventricular contraction. Variations in the temperature of the blood and the volume of the escaping drops were too slight to affect the correctness of the conclusions.

Intraventricular pressure curves were presented to demonstrate the following

facts: A fall in the volume of the coronary circulation, *e. g.*, 73 %, caused a fall in the force of the heart beat of 49 %, while the frequency was altered but 9 %. Restoring the volume of the coronary circulation restores the force and frequency of the heart beat. The change in force follows the change in blood supply immediately. These and other related observations are about to be published in the *Journal of Experimental Medicine*, by J. B. Magrath and H. Kennedy.

Miss Hyde has studied by the same method the effect of distention of the heart on the volume of the coronary circulation. Distension of the left ventricle, *i. e.*, making a constant pressure in the ventricle through a side branch of the membrane manometer tube, diminishes *per se* the volume of the coronary circulation. Distention acts further as a stimulus to the cardiac muscle, causing the ventricle to beat more strongly. Strong contractions of the ventricle cause an increase in the volume of the coronary circulation. If the ventricle, having been distended, is placed again at atmospheric pressure, the force of contraction is much diminished.

Dr. Porter also showed curves recording the diminution in coronary flow occasioned by stimulation of the peripheral end of the vagus nerve. Increase in coronary circulation follows stimulation of the cervical sympathetic. These results indicate vasoconstrictor fibres in the vagus and vasodilator fibres in the sympathetic.

Later Dr. Porter demonstrated his method of isolating the cat's heart for purposes of physiological investigation.

On the duration of cardiac standstill with different strengths of vagus stimulation. T. Hough.

A stimulus of uniform strength was obtained by the use of a storage battery in the primary circuit, which was interrupted by the revolutions of a small electric motor run at a constant rate of speed; the strength of stimulus was varied by changing the resistance in a German silver rheochord placed in the primary circuit. It was found that when the inhibitory impulses, obtained by stimulation of the vagus nerve, are just strong enough to bring the heart of the dog to rest, the duration of stand-still is not so long as with stronger stimuli; but that a very slight increase of stimulus above this point produces a stand-still which is not lengthened by any further strengthening of the inhibitory impulses. The conclusions drawn from previous work on the same subject (Journal of Physiology, XVIII., 190) are, therefore, correct.

Some experiments on the relation of the inhibitory to the accelerator nerves of the heart. R. Hunt.

Some of the effects of stimulating the two nerves separately were first described; then the result of stimulating the nerves simultaneously. The experiments show that, contrary to the commonly accepted opinion of Baxt, the inhibitory and accelerator nerves are to be regarded as purely antagonistic; that the result of stimulating the two together is approximately the algebraic sum of the effects produced by stimulating them separately. In no case did one nerve completely overcome the effect of the other, though the two were stimulated for periods as long as twelve minutes. The experiments were performed upon dogs and cats.

Exhibition of plethysmographic curves obtained during sleep, with remarks. W. H. Howell.

Prof. Howell exhibited plethysmographic curves showing the changes in volume of the hand and wrist during the period of normal sleep. The apparatus was so arranged as to register the actual changes in volume without altering the pressure upon the parts under observation. The curves showed that from the beginning of the at-

tempt to go to sleep a gradual increase in volume took place, the unconsciousness of sleep appearing at some point during this increase. The volume reached its maximum within one or two hours after the beginning of sleep, and then for an hour or two remained practically constant. Following upon this there appeared a gradual constriction, which at first was very gradual, but increased more rapidly during the last half or three-quarters of an hour of sleep, and brought the volume curve at the time of awakening nearly or quite to the point shown at the beginning of sleep. The curves exhibited also throughout the sleeping period long periodic waves of constriction and expansion, lasting for an hour or more, and numerous shorter rapid constrictions and expansions, which were connected with the movements of the sleeping subject or with external stimuli such as noises in the street.

Upon the assumption that the increased volume was owing to a vascular dilatation, particularly in the skin, the author pointed out that upon the accepted view of the regulation of blood supply in the brain, the volume of circulation and the pressure within this organ during sleep must stand in reciprocal relations to the volume changes exhibited by the limbs, that is, during the period of sleep the blood supply to the brain and intracerebral pressure gradually diminish to a minimum which is reached within the first one or two hours; this condition remains practically constant for the following hour or two, and is then succeeded by a gradual increase in blood flow and intracerebral pressure, which may be said to reach the normal condition at the time of awakening. The author explained the vascular changes by a fatigue and subsequent resumption of tone in the vaso-motor center, especially in that part controlling the skin circulation. He pointed out the want of parallelism between the curves of intensity of sleep and the curves showing the vascular changes, and developed a theory of sleep which referred the immediate cause of sleep and of spontaneous awakening to the conditions of blood supply and pressure in the brain, which are indirectly controlled by the state of the vaso-motor center.

The relation between height, weight and age in growing children. H. P. BOWDITCH.

Prof. Bowditch showed curves derived from his own observations on Boston school children, and those of Dr. Porter on St. Louis children, showing that the relation between height and weight varies with the age in such a way that older children are heavier in proportion to their height than younger children.

On the contraction of the stomach produced by direct stimulation and by stimulation of the vagi with the faradic current. S. J. MELTZER.

1. Bipolar faradic stimulation with a current strong enough to produce a maximal contraction when applied to the serosa usually fails to produce any local or peristaltic contraction of the muscularis of the stomach, when applied to the mucous membrane of any part of the stomach. 2. When the faradic stimulus is applied to the serosa the effect varies according to the part of the stomach which is stimulated. As regards contractility, the stomach possesses a negative and a positive pole; the extreme end of the fundus does not even with very strong stimuli contract, while the pyloric end responds to a moderate stimulus with a strong contraction. The parts lying between the poles show a gradual transition from one extreme into the other; the further from the left end of the stomach, the walls contract more readily and more strongly. 3. Stimulation of the pneumogastric nerves causes a distinct contraction, which is strongest after the cessation of the stimulation. This contraction is also

mainly limited to the right part of the stomach.

Later Dr. Meltzer demonstrated the above stated results on the stomach of a well anæsthetized dog.

An experimental investigation of some of the conditions influencing the secretion and composition of bile. (With Mr. A. Balch.) Fr. Pfaff.

The subject of the investigation was a female patient of the Massachusetts General Hospital. Dr. H. H. A. Beach had operated on the patient for distention of the gall bladder. As a result of the operation a fistula remained, through which all the bile secreted was discharged. The jaundice, which existed before, disappeared completely in the course of a few weeks, the urine becoming bile free. The fæces remained completely clay-colored. At the time the investigation was begun by Dr. Pfaff and Mr. A. Balch, a student in the Harvard Medical School, the patient felt perfectly well. The bile escaping through the fistulous opening was collected in graduated jars, measured and analyzed every six hours. The specific gravity, the total amount of solids, and the ash of each sample of bile were determined.

The influence of human bile, ox bile, salol, sublimate, calomel and a mixture of pure bile salts on the daily excretion and the composition of the bile was studied. Human bile, ox bile and the mixture of the pure bile salts, dried and made into pills, increased the daily secretion and the amount of solids. Salol had scarcely any effect. Sublimate and calomel, if anything, slightly decreased the daily secretion. During the time of observation, ninety-seven days, the patient remained perfectly well, and has increased in weight from 113½ to 127 pounds.

The production of sugar from gelatine in metabolism. G. Lusk.

Experiments described at the last meeting showed that subcutaneous injection of phlorhizin every eight hours into starving rabbits produced, after the first day, the removal of dextrose through the urine in a constant ratio to the nitrogen eliminated at the same time. The ratio may be represented thus: D : N :: 2.8 : 1. This condition the author terms 'total phlorhizin diabetes,' since the ratio is the same as obtained by Minkowski after the extirpation of the pancreas in dogs, in 'total pancreas diabetes.' If rabbits with total phlorhizin diabetes be fed with 5 grams of gelatine, there is a simultaneous rise in both sugar and nitrogen in the urine of the corresponding day, showing respectively the absorption of the gelatine and the production of sugar from it. The proportion between dextrose and nitrogen is represented in one case by 2.5 : 1. Further experiments upon dogs, to whom gelatine is obviously a more natural food than to rabbits, are in progress in the author's laboratory. According to Külz 'phloridzin' and 'phlorizin' are false orthography.

Demonstration of a convenient form of apparatus to avoid explosions in gas analysis. G. T. Kemp.

The apparatus is a new and simple form of grisoumeter for use with mercury. The gas mixture, instead of being exploded by the electric spark, is subjected to the action of a platinum spiral heated white hot by an electric current. This causes the complete combustion of gases in non-explosive proportions, obviates the addition of explosive mixtures, and allows the gases that are to be analyzed, when present in small amount, to be diluted with a neutral gas to a volume convenient for handling in the different steps of the analysis.

The structure of the sympathetic ganglia of vertebrates, with demonstration of preparations. G. C. Huber.

Sympathetic ganglia taken from various

fishes, amphibians, reptiles, birds and mammals were studied by means of methylene blue and alum carmine as in the subsequent paper. The cells of the sympathetic system are multipolar, except in the amphibians, where large unipolar cells are found. The multipolar neurons have several protoplasmic branches (dendrites) and one axis cylinder (neuraxis); the unipolar cells have the neuraxis only. The cell body of the neurons is enclosed within a nucleated capsule. The dendrites break up into a system of finer branches which terminate between the ganglion cells; the plexus is extracapsular. Large medullated fibres and sympathetic fibres end in the ganglion.

The large medullated fibres branch repeatedly in the ganglion, ultimately terminating in pericellular end-baskets, which enclose the bodies of the sympathetic cells. These end-baskets are always intracapsular, and show different degrees of complexity in the various classes of vertebrates. In fishes they may be either very simple, composed only of a few fibrillæ, or very complex; in the latter case some of the fibrils of the end-basket enclose the cell body of the neuron in question, while others seem to end between small cells, the nature of which has not yet been determined, but which are also within the capsule of the cell. In amphibians the medullated fibres are twisted spirally about the axis cylinders of the unipolar cells here found, before terminating in the end-baskets enclosing the bodies of the cells. In reptiles the appearances vary greatly in different ganglia and in different parts of the same ganglion. Here, also, very simple end-baskets may be found; again the medullated fibre may make one, two, three or four turns around the axis cylinder of a sympathetic cell before breaking up into the finer branches of its end-basket, and finally very complicated endings may be observed, where one or several medullated fibres are wound separately around the axis cylinder and the adjacent portion of a sympathetic neuron before terminating in a very complex intracapsular end-basket. In birds and mammals the medullated fibres terminate in end-baskets which, as a rule, are rather simple, being composed of terminal fibrillæ, more or less loosely interwoven and always found between the body of a sympathetic ganglion cell and its capsule.

Sympathetic nerves ending in a ganglion break up into fine branches, which would seem to terminate in free endings on the protoplasmic branches of the sympathetic cells of the ganglion without forming end-baskets.

This conclusion has been drawn: The large medullated fibres ending in pericellular baskets come from the cerebro-spinal system and place the sympathetic ganglia in connection with the brain and cord, while the sympathetic fibres with free endings come from other sympathetic ganglia.

Remarks on the ending of nerves in muscle tissue, with demonstrations. G. C. HUBER.

The methods used in preparing the sections was the following: A 2 per cent. solution of methylene blue in normal salt solution was injected into a vein. Some time after the injection the tissues were exposed and developed in the air. As soon as the motor endings were recognized in the fresh muscle, the tissues were fixed in ammonium molybdate (Bethe), dehydrated in alcohol, embedded in paraffine, and sectioned. The sections were then fixed to a slide, stained in alum carmine and mounted in balsam. In order to determine with some degree of certainty the relation of the end-organs to the muscle fibres, the latter were cut in both horizontal and cross-sections. The conclusions are as follows:

A. Voluntary muscle (rabbit). The granular sole is an accumulation of sarcoplasma at the point of entrance of the nerve;

the nuclei of the sole are nuclei of the sarcoplasma. The axis cylinder of the motor nerve ends in an end-brush in the sarcoplasma. The neurilemma becomes continuous with the sarcoplasma.

B. Heart muscle (cat and dog). Axis cylinders of sympathetic ganglion cells terminate *on* the heart muscle cells either as very simple endings, namely, one or two very fine end-branches which terminate in small granules or bulbs, or in somewhat more complicated end-organs composed of several small twigs, these usually ending also in the bulbous enlargement.

C. Involuntary muscle (cat, rabbit and tortoise). The ending here is very simple. The terminal branches of the axis cylinders course along between the involuntary muscle cells, giving off in their course very fine side branches which end on the cells often near the nucleus.

The functional development of the cerebral cortex in different groups of animals. W. Mills.

The dog, cat, rabbit, guinea pig, rat and mouse were studied. Only those animals were used whose exact age was known, and ether was the anæsthetic invariably employed. The research was carried on in connection with investigations on the psychic development of the same animals. The following are among the most important conclusions drawn:

In the dog, cat, rabbit (and, in so far as the author's experiments go, in the rat and mouse) neither the brain cortex nor the underlying white matter is excitable by electrical stimulation at birth or for some days afterwards. The cortex is usually not excitable till about the period when the eyes open, though there are exceptions to this rule, most frequently in the author's experience in the cat, in favor of an earlier date. The white matter of the brain just beneath the cortex is generally excitable either at an earlier date than the cortex or with a weaker stimulus. The reaction for the limb movements is obtainable invariably somewhat earlier in the dog and the cat, and generally so in the rabbit, than those for the neck, face, etc. Localization for the cortex, and still more for the white matter, is at first ill defined, but gradually, though rapidly, becomes more definite. In the cavy (guinea pig) the cortex and the white matter beneath are electrically excitable either at birth or a few hours afterwards, and perfection of reaction and localization is reached in a few days. Before the brain cortex responds to electrical excitation, ablation of the motor area (centers) leads to no appreciable interference with movements. The younger the animal, the stronger the current required to produce reaction up to the time that localization is well established, *i. e.*, the weakness of the current required to cause a movement is an indication of the degree of development of the center in question. Differences for breeds and individuals exist and constitute to some extent exceptions to the above general statements.

In the above, 'cortex' refers to the gray matter in or near the motor area, and 'white matter' to the brain substance immediately beneath.

The restoration of coördinate power after nerve crossing. R. H. Cunningham.

Read by title.

The proteolytic action of papain. R. H. Chittenden.

The exact relationship of the vegetable proteolytic enzymes to the corresponding enzymes of animal origin has never been quite clear. The conditions governing the action of both papain and bromelin indicate a closer relationship to trypsin than to pepsin. The products found, however, appear to differ somewhat both chemically and physiologically from the corresponding products formed by animal enzymes. Brom-

elin, the ferment of pineapple juice, like trypsin, is unquestionably a typical peptone-forming enzyme. Quite recently, however, a number of investigators have stated that papain is unable to form peptone, *i. e.*, that its digestive action is limited to the formation of proteoses. The present experiments made mainly by Mr. McDermott, on the other hand, clearly show that papain is able to form true peptone quite readily from coagulated egg albumin, from blood fibrin and from the coagulated proteids of muscular tissue. This peptone-forming power is manifested in a few hours at 40° C., and in the presence of one per cent. sodium fluoride, thymol or chloroform water.

Experiments on the physiological influence of alcohol. C. F. HODGE.

The experiments reported have been conducted during the past three years for the Committee of Fifty, the purpose being to collect impartial data in the general physiology of the subject. Attention has been directed chiefly along three lines, namely, the influence of alcohol: 1st, upon growth, including reproduction; 2d, upon psychic development; 3d, upon animal activity and ability.

Experiments, already reported, upon the growth of yeast proved that in fresh cultures an addition of $\frac{1}{1000}$ of one per cent. of pure alcohol retarded growth materially proportionately much more than larger amounts.

Experiments upon kittens and puppies were made as follows: Two pairs of kittens as much alike as possible, the males from one litter, the females from another, were selected. Alcohol in moderate doses was given to one pair, the other pair being kept on normal diet for comparison. At the end of ten days' administration of alcohol the alcoholic pair had contracted severe colds, and alcohol was discontinued until recovery should take place. This, however, did not occur, so that the administration of alcohol was permanently discontinued. Curves of weight showed that the alcoholic pair had been dwarfed, the male and female attaining only 39 % and 63 % respectively of the weight of their controls. From later developments in the course of the experiment, it is probable that this stunting effect is to be ascribed chiefly to the disease rather than to the alcohol. The alcoholic kittens became very quiet, various psychic characteristics, notably playfulness, purring, fear of dogs and game instincts, dropping out with great abruptness. Disease becoming thus intercurrent, however, renders any definite interpretation of the experiment impossible.

Similarly two pairs of cocker spaniel puppies were carefully selected, the males brothers, the females sisters. Great care was taken to avoid pathological complications and to keep the experiment as strictly as possible on physiological lines. Accordingly non-intoxicant doses were used and were increased as the puppies grew. These now amount to 35 and 38 cc. of absolute alcohol for the female and male respectively; that is, about 4 cc. per kilo of body weight has been given daily since the puppies were nine weeks old. Growth has been practically normal, the alcoholic pair even growing a little faster than their controls at first. Possibly four dogs could hardly be found to grow more uniformly under normal treatment. Each normal animal is, however, about 5 % heavier than its alcoholic brother or sister. On the side of the reproductive functions, too, the puppies of the alcoholic pair are not inferior to those of the normals.

The chief difference is on the psychic side. Both the alcoholic animals are much quieter than their controls and both are abnormally timid. As tested by the pedometer method the alcoholic male was found to develop 71 % of the daily activity of his brother, the female only 57 % of her sister. Much severer

tests of ability were made by throwing a ball, the dogs competing on equal terms for its possession and for the privilege of bringing it back. In two series of tests made in this way, 1,400 and 1,000 balls being shown, the alcoholic male has shown an efficiency of only 32% and 44% as compared with that of his brother. On account of differences in condition, no satisfactory test has been possible as yet with the females.

A series of photographs taken at intervals during the research was exhibited.

The physiological action of nitrous oxide. G. T. Kemp.

It has been claimed that the supposed anæsthetic properties of nitrous oxide are due to its asphyxiating power. A careful comparison of its physiological action with that of a neutral gas, such as nitrogen, shows that in nitrous oxide separate anæsthetizing and asphyxiating powers may be demonstrated. To supplement this, a series of analyses of the blood gases of animals asphyxiated by nitrous oxide shows that anæsthesia may be obtained with this gas while the blood is still carrying sufficient oxygen to meet the demands of the system. Work with nitrous oxide and oxygen indicates that soon an anæsthetic may be recommended, which will be effective and yet avoid the objections applying to chloroform and ether.

On bactericidal effects of lymph from the thoracic duct. (With Dr. Charles Norris.) S. J. Meltzer.

In contrast to the surprising statements of Max Neisser that the lymph coming from the thoracic duct does not contain bactericidal properties, the authors find the lymph coming from the thoracic duct of dogs to be distinctly germicidal for the typhoid bacillus. The bactericidal power of the lymph differs from that of the blood in not becoming exhausted even after days. Neisser apparently employed unreliable methods.

On the interpretation of the so-called latent period of the motor nerve-endings, and on the supposed demonstration of their exhaustibility. F. S. Locke.

The replacement by mere contact of the continuity formerly believed generally to exist between irritable structures would seem to necessitate more attention being given to the 'discharge hypothesis,' on which Kühne has especially insisted—namely, that the motor nerve-fibre stimulates the muscle-fibre by means of its action current, which acts as an electric stimulus. The author's experimental results favor the view that the so-called latent period of the motor nerve-endings, which has been held by Bernstein and others to be crucial against the hypothesis, may be due to the nature of the electric stimulation by the action current. It was found that the secondary stimulation of one frog's sartorius muscle by the action current of another is associated with a measurably longer latent period than is stimulation with an induction shock.

Another argument against the 'discharge hypothesis' might conceivably be founded on the supposed exhaustibility of the motor nerve-endings. It was found, however, that if the curarised sartorius be continuously tetanised by make and break shocks through one pair of electrodes, till 'exhaustion' is complete or nearly so, then sending the tetanising shocks through another pair of electrodes situated on different points of the muscles gives again good tetanus. 'Exhaustion' in consequence of electric tetanisation is, therefore, primarily polar, and the results that have been supposed to demonstrate the exhaustibility of motor nerve-endings are readily reconcilable with the 'discharge hypothesis,' local 'exhaustion' of the muscle substance immediately in

contact with the nerve-endings replacing fatigue of these themselves.

The 'discharge hypothesis' affords a new conception of the real nature of inhibition and accounts for the actual properties of inhibited muscle. The anelectrotonus of the muscle substance, which must necessarily accompany the more active katelectrotonus even in the case of the action current of the motor nerve-ending, may not inconceivably become by greater anodic current density the more active in the case of the action current of inhibitory nerve-endings, and be the essential factor in the production of inhibition.

Gum arabic and the frog's heart. F. S. LOCKE.

The author has again found, in contradiction to M. Albanese's recent statement, that sodium arabate, unlike gum arabic (from which it differs by containing sodium in place of calcium, magnesium and potassium), confers no special sustaining power on 6 per cent. sodium chloride solution, weakly alkalinized with sodium carbonate and saturated with oxygen.

The measurement of the output of the heart. G. N. STEWART.

A solution of a substance (*e. g.*, sodium chloride), which can be easily recognized and quantitatively estimated in the blood, is allowed to flow at a known rate for a measured time through the external jugular vein into the heart. When the mixture of blood and injection liquid has reached a convenient point of the arterial system beyond the heart, *e. g.*, the femoral artery, a sample is drawn off during its passage. From the composition of this sample, the amount of blood with which the injection liquid must have been mixed in the heart, that is, the outflow (or inflow) of the heart during the time of injection, is determined. The electrical resistance of the mixed fluid being different from that of the blood, a telephone is employed to announce the time of arrival at the point of observation. So far the results seem to show that the more recent measurements of Tigerstedt, Stolnikow, etc., are too low, while those of the older observers (Volkmann, etc.) are too high.

As a preliminary to this investigation the author shows that when the time of injection is not too short it is approximately equal to the time of passage of the altered blood through a given cross-section of the carotid or femoral artery. The circulation time of the lungs, as determined by the injection of methylene blue in rabbits and of NaCl by the telephone method in dogs, is approximately the mean pulmonary circulation time and not the minimum. This is also the case for such artificial schemes as approach the condition of a vascular capillary tract.

Demonstrations of apparatus. G. W. FITZ.

1. A spring cylinder chronograph for spark records.

2. A lever system to illustrate the action of muscles in relation to joints.

3. A form of student's myograph.

4. A modification of the location reaction apparatus.

Demonstration of preparations of the nerve cell under acute alcoholic poisoning. C. F. HODGE (for C. C. Stewart).

Specimens to illustrate Mr. Stewart's recent paper (Journal of Experimental Medicine, Vol. I., No. 4, 1896) were demonstrated to the Society. In the experiment cats were used, one being held in alcoholic stupor for 54½ hours, a second 50 minutes, death being caused by alcoholic poisoning in both cases, and a third being killed by decapitation. From the three animals, thus dead at the same time, corresponding portions of the nervous systems were removed and immediately placed in the same dishes of the several fixing and hardening

reagents employed. The sections demonstrated were those obtained from the cerebrum, cerebellum and spinal cord by the alcohol-methylene-blue method. It was easily observable, even by the unaided eye, that the sections from the normal animal stained much more deeply than those from either of the animals killed with alcohol. Material from the animal killed in 50 minutes was also easily seen to be stained somewhat more deeply than that from the animal killed in 54½ hours. Methylene blue, as thus applied, has been found to be especially good for staining the granules in the cell protoplasm. Absence of stain in the alcoholic material would thus seem to indicate that alcohol, as above applied, had either destroyed the characteristic granulation of the cell protoplasm or so changed the cell contents that it is no longer able to hold the stain.

Prof. W. H. Howell proposed the following resolutions regarding the work of the late Prof. H. Newell Martin: "The members of the American Physiological Society have heard, with profound regret, of the death of Prof. H. Newell Martin. In commemoration of his distinguished services the Society adopts and places upon its official record the following expression of its appreciation and esteem. In the death of Prof. Martin the Society has lost a member to whom it owes an especial debt of gratitude. He was actively concerned in its foundation and organization, and during the critical period of its early history he gave much time and thought to its interests. He served for six years as its Secretary and Treasurer, and strove always with enthusiasm to make a successful beginning of an enterprise which he believed would foster the spirit of scientific research in physiology and bring its active workers into stimulating fellowship. For its present prosperous condition and its prospects of future usefulness the Society feels that it is largely indebted to his wisdom and energy. In a broader field his influence upon the science of physiology has been deeply felt. His own splendid contributions to experimental physiology will have an enduring value, while the stimulus given by him to others has been, and will continue to be, an influential factor in the development of physiological instruction and research in this country. As an investigator and teacher he was distinguished not only by his originality and ability, but by many noble traits of character. His modesty, his genuine interest in all kinds of biological work, his steady insistence upon the highest ideals of scientific inquiry, his chivalrous conception of the credit due to his fellow-workers, and the generous sympathy and appreciation always felt and shown by him for the work of younger investigators, are some of the qualities which will endear his memory to those who were so fortunate as to be brought into intimate association with him as teacher or as friend."

Prof. H. P. Bowditch, in seconding the resolution, said: "Probably few of the younger members of the Society are aware of the great debt which we owe to Dr. Martin for establishing the high standard which the Society has always maintained with regard to the qualifications of the members. It was always Dr. Martin's contention that a candidate for admission to our ranks should be required to demonstrate his power to enlarge the bounds of our chosen science, and not merely to display an interest in the subject and an ability to teach text-book physiology to medical students. To his wise counsel in this matter the present prosperity of the Society is, I think, largely to be attributed. I trust that the resolution will be adopted and spread upon the records of the Society."

The resolution was unanimously adopted.

A cordial invitation to the members of the Society to join the British Association

for the Advancement of Science at its Toronto meeting in August, 1897, was received and accepted with thanks.

The following gentlemen were elected to membership: Prof. A. B. Macallum, M. B., Ph.D., Toronto University; Prof. W. S. Carter, M. D., University of Pennsylvania; L. B. Mendel, Ph.D., Yale University.

The following officers were elected: Council: R. H. Chittenden, Yale, President; F. S. Lee, Columbia, Secretary and Treasurer; H. P. Bowditch, Harvard; W. H. Howell, Johns Hopkins; W. P. Lombard, Michigan.

FREDERIC S. LEE,
Secretary.

COLUMBIA UNIVERSITY.

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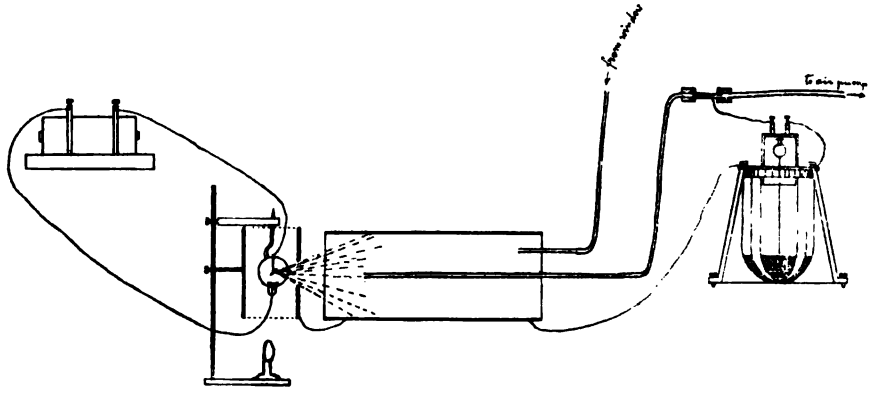
*ELECTRIFICATION OF AIR BY RÖNTGEN RAYS.**

To test whether or not the Röntgen rays have any electrifying effect on air, the following arrangement was made.



A lead cylinder 76 cm. long, 23 cm. diameter, was constructed; and both ends were closed with paraffined cardboard, transparent to the Röntgen rays. Outside the end distant from the electrometer (see diagram) a Röntgen lamp† was placed. In the other end two holes were made, one in the middle, through which passed a glass tube (referred to below as suction pipe) of sufficient length to allow the end in the lead cylinder to be put into any desired place in the cylinder. By means of this, air was drawn through an electric filter* by an air pump. The other hole, at a little distance from the center, contained a second glass tube by which air was drawn through india rubber tubing from the open-air quadrangle outside the laboratory.

In one series of experiments the end of the suction pipe was kept in the axial line of the lead cylinder at various points 10 cm. apart, beginning with a point close to the end distant from the Röntgen lamp.

In every case the air drawn through the filter was found to be negatively electrified when no screen or an aluminium screen was interposed between the Röntgen lamp and the near end of the lead cylinder. The air was found not electrified at all, or very slightly negative, when a lead screen was interposed.

When the Röntgen lamp was removed or stopped, and air was still pumped through the filter, no deflection was observed on the electrometer. This proved that the air of the quadrangle was not electrified sufficiently to show any deflec-

* Read before the Royal Society of Edinburgh, Monday, December 21, 1896. From proof-sheets of *Nature*, contributed by Lord Kelvin.

† The Röntgen lamp was a vacuum vessel with an oblique platinum plate (Jackson pattern).

* Kelvin, Maclean, Galt, Proc. R. S., London, March 14, 1895.

tion when thus tested by filter and electrometer.

Similar results were obtained with the end of the suction pipe placed so as to touch the floor of the lead cylinder, or the roof, or the sides. Whether the air was pumped away from a place in the cylinder permeated, or from a place not permeated, by the Röntgen rays, it was in all cases found to be negatively electrified.

The following are some of the results obtained on December 16th and 17th. The electrometer was so arranged as to give 140 scale divisions per volt.

Conditions.—Large lead cylinder metallically connected with sheath of electrometer. Röntgen lamp surrounded by a lead sheath, which latter was also connected to electrometer sheath. There was a window in this lamp sheath 2.5 cm. broad and 5 cm. high. This window could be screened by aluminium or by lead. These screens were always connected metallically to sheaths. During all the experiments a Bunsen lamp was kept constantly burning, with its flame about 30 cm. below the Röntgen lamp.

Results.—Röntgen lamp in action; air drawn from lowest point of end of lead cylinder next to the R. lamp.

December 16, 3.55 p. m.

—61	scale divisions	in	2	mins.	with	aluminium	screen.
—63	"	"	"	2	"	"	no screen.
—14	"	"	"	2	"	"	lead screen.

4.20 p. m. Air drawn from point on lower line of lead cylinder 26 cms. distant from R. L. end.

—14	scale divisions	in	2	mins.	with	lead	screen.
—78	"	"	"	2	"	"	no screen.
—24	"	"	"	2	"	"	lead screen.
—83	"	"	"	2	"	"	alumin. screen.
—13	"	"	"	2	"	"	lead screen.

December 17.

R. L. acting, and air drawn through filter.

End of suction pipe kept in axial line of cylinder.

10.47 a. m. cms.

—44	in	2	mins.	with	alumin.	screen,	68	from R. L. end.
0	"	"	lead	"	68	"	"	
—28	"	"	no	"	58	"	"	
—24	in	2	mins.	with	no	screen,	48	from R. L. end.
0	"	"	lead	"	48	"	"	
—23	"	"	alumin.	"	48	"	"	
—26	"	"	alumin.	"	38	"	"	
— 9	"	"	lead	"	38	"	"	
— 7	"	"	lead	"	28	"	"	
—26	"	"	alumin.	"	28	"	"	
—36	"	"	alumin.	"	18	"	"	
—21	"	"	alumin.	"	8	"	"	

We had previously made experiments with a sheet-iron funnel 1 metre long, 14.5 cms. diameter; and with a glass tube 150 cms. long, 3.5 cms. diameter; and with an aluminium tube 60 cms. long, 4.5 cms. diameter. Air was pumped from different parts while the Röntgen rays were shining along the tubes from one end, which was closed by paraffined paper stretched across it. In every case the air was found to be negatively electrified.

In those earlier experiments the air drawn away was replaced by air coming in from the laboratory at the open end of the tube. We found evidence of disturbance due to electrification of air of the laboratory by brush discharges from electrodes between the induction coil and Röntgen lamp, and perhaps from circuit-break spark of induction coil. These sources of disturbance are eliminated by our later arrangement of lead cylinder covered with cardboard at both ends, as described above, and air drawn into it from open air outside the laboratory.

We have also found a very decided electrification of air—sometimes negative, sometimes positive—when the Röntgen rays are directed across a glass tube or an aluminium tube, through which air was drawn from the quadrangle outside the laboratory, to the filter.

A primary object of our experiments was to test whether air electrified positively or negatively lost its charge by the passage of Röntgen rays through it. We soon obtained an affirmative answer to this question, both for negative and positive elec-

tricity. We found that positively electrified air lost its positive electricity, and in some cases acquired negative electricity, under the influence of Röntgen rays; and we were thus led to investigate the effect of Röntgen rays on air unelectrified to begin with.

Note on diagram.—For the sake of simplicity, the screening of the electrometer is not shown in the diagram. In carrying out the above experiments, however, we have found it absolutely necessary not only to surround the electrometer with wire gauze in the usual manner, but we have had also to place a sheet of lead below it, and to screen also the side next the Röntgen lamp by a lead screen. In some cases it was even necessary to cover up the whole with paper to prevent the electrified air of the room from disturbing the instrument.

KELVIN,
J. C. BEATTIE,
M. SMOLUCHOWSKI DE SMOLAN.
PHYSICAL LABORATORY,
UNIVERSITY OF GLASGOW,
December 19, 1896.

CURRENT NOTES ON ANTHROPOLOGY.

ORIGIN OF ROCK PAINTINGS.

A VALUABLE article is published in the Bulletin of the American Museum, Vol. VIII., by James Teit, on a rock painting of the Thompson River Indians, British Columbia.

It appears that young girls, on reaching maturity, retire for a season of solitude, meditation and purification. At its close they paint on some rock, with red ochre, their psychical experiences and the rites they have performed. An example is given with its interpretation.

This origin of pictographs is not mentioned, I think, in Col. Garrick Mallery's extensive work. The figures are curious and suggestive. They appear to be conventional and can be read by any woman of the tribe. This shows that they are taught to the young girls, and we thus find a recognized graphic system prevailing in this rude tribe.

THE MEANING OF MOURNING.

VARIOUS ethnologists have claimed that the laments, the mutilations and howls of the survivors around the corpse in primitive nations are chiefly for their own benefit, to keep away the ghost, as that is usually considered malevolent.

The subject is discussed by K. T. Preuss, in the *Globus*, November, 1896, in an article 'Die Totenklage im alten Amerika.' Some instances, he believes, justiy the above assertion, but the majority do not. The wailing and weeping, often continued for months, he regards as generally indications of personal sorrow at the loss sustained.

This natural and satisfactory explanation is supported by the most intelligent officers of our regular army who have seen intimately the home life of our western Indians. For instance, the late Captain W. P. Clark, 'the white chief with the talking hand,' expresses himself positively to this effect, in his *Indian Sign Language*, p. 263.

PRIMITIVE TRAVEL AND TRANSPORTATION.

AN essay with this title, by Prof. O. T. Mason, occupies more than 350 pages of the last Report of the United States National Museum. In completeness of presentation and wealth of material it far surpasses any other study of the subject, and leaves little to be desired until we have materially extended our collections of early objects. There are 260 figures inserted in the text, illustrating all sorts of native conveyances —cradles, baskets, shoes, sandals, staffs, carrying gear, tree-climbing devices, snow goggles, etc.—and the mode in which they were used. Roads, bridges, journeys, camping grounds and other matters pertaining to primitive travel claim a part of the author's attention.

Prof. Mason intends to follow up this excellent piece of work with a primitive trade-route map of the United States and Canada, including trails and portages. He will be gratified to receive information on these points from travelers and explorers, or references to where such may be found. His address is the National Museum, Washington, D. C.

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

MODERN ARMY RIFLES.

The portions of the Governor's message of January, 1895, to the Legislature of the State of New York referring to the re-arming of the State troops; the Law passed May 10th, in compliance with its suggestions, and the rules of procedure of the New York State Board appointed to select improved arms for the militia of the State; the report of that Board, September, 1895, and the Governor's message of October 22d, relating to the report, are just published in pamphlet form by the Savage Arms Co., of Utica, N. Y., the makers of the gun selected by the Board. This makes a convenient compendium for those interested in the subject. A table is also included showing the dimensions and character of the rifles adopted for military purposes by the governments of the world; substantially all of which have adopted a small calibre, usually about 0.30 inches, and smokeless powder. The United States has accepted this specification for its army rifle, but the navy gun is of but 0.236 inches bore. Curiously enough, all of the States of the Union have armed their troops with the U. S. Springfield gun, except New York, which has the most antiquated of rifles, of large calibre; and all the militia of all the States are using black powder.

The N. Y. State Board reported in favor of a 'lever action,' in preference to the 'bolt action' adopted by all the nations of Europe, as being in all respects superior to the latter and as having the further advantage of being a generally used American invention, and hence familiar, already, to all habitual users of the rifle in the United States. A stronger metal for barrels than heretofore employed is specified, and the study of nickel steel as a material for such guns is advised. That alloy is already adopted by the United States Navy, both for small arms and for ordnance and armor. The Board suggests the attempt to secure at least an elastic limit of 75,000 pounds per square inch, tenacity of 110,000 or 120,000 pounds, and at the same time a ductility of at least 20 per cent. in eight inches. It is thought possible to secure these figures, which would insure an extremely strong, yet light and very safe, barrel. The United States Army regulation bore, chamber and rifling are advised, in order to secure uniformity of ammunition. The Board seems doubtful whether the higher velocity, approximating 2,300 feet per second, greater range, attaining something like two miles, and higher penetrative power of the small bores used by our own navy, and by several foreign nations, is not, on the whole, compensated by more serious disadvantages in loss of 'stopping power' and difficulties of manufacture and manipulation. The gun selected has a muzzle velocity of 1,950 feet and a range of about a mile and a-half.

The use of the 'clip' for holding cartridges is not found desirable, with a satisfactory form of magazine and mechanism. The use of the gun as a single loader, with a reserve in the magazine, is thought likely to prove, in action, the usually desirable arrangement.

Twelve guns were entered for examination and report. Their behavior under test, according to the statement of the Board, "is believed to have been the most wonderful performance of new magazine rifles of different patterns of which a record is known. It was a splendid exhibition of American skill and genius in the invention of effective military magazine arms."

The report is unanimous and is signed by Messrs. Albert D. Shaw, of Watertown; E. W. Bliss, of Brooklyn, and R. H. Thurston, of Ithaca, N. Y.

GENERAL.

The cable dispatch (see page 103 in the last number of this Journal) regarding the disposition of the fortune of the late Alfred Nobel is confirmed by later advices. The annual income

will amount to about $300,000, and four-fifths of this sum is to be spent in four prizes for advances in science. The competition will be open to Scandinavians and foreigners on equal terms. All men of science will look forward with great interest to learning the details of this bequest—probably the most noteworthy ever made for public purposes—and the methods to be followed in awarding these great prizes.

THE widow of Baron Maurice Hirsch, of Vienna, has resolved to present about $400,000 to the Pasteur Institute as a memorial of her husband. Part of this sum will be used for building chemical and biological laboratories.

THE will of the late Robert H. Lamborn, which bequeathes about $200,000 to the Academy of Natural Sciences of Philadelphia, has been admitted to probate.

IT was reported at the Frankfort meeting of the German naturalists and physicians that 255,000 Marks had been collected for the memorial to the eminent chemist von Hoffmann. This will be used for the erection of a building to be known as the 'Hoffmann Hausa,' to be used as the headquarters of the German Chemical Society. It is proposed to establish in it a laboratory and a library, which latter includes the books left by von Hoffmann.

THE late General Cullum left $100,000 to the American Geographical Society, New York, for a building, and also bequeathed a further sum, to be known as the Cullum Geographical Medal Fund, for a gold medal to be given to those who should render most distinguished services to geographical science, and particularly to American citizens. The first medal has been awarded to Mr. R. E. Peary, U. S. N., for having established the insularity of Greenland.

PROFESSOR BEHRING has been awarded the Rinecker prize consisting of a gold medal and 1000 Marks by the University of Würzburg, for his discovery of the Anti-toxin treatment of diptheria.

THE British Institute of Public Health has awarded the Harben medal for 1897 to Professor M. von Pettenkofer, emeritus professor of hygiene in the University of Munich.

THE Bressa prize of the Reale Accademie delle Scienze, of Turin, will be awarded for the eleventh time in 1899. The prize, which is of the value of nearly $2,000, is given for the most important scientific work produced during the years 1895–98. Competitors must send their contributions in print before the end of the present year. The academy reserves the right to award the prize to one who has not entered his name among the competitors.

A STATUE of the late Samuel Gross, the eminent Philadelphia surgeon, will be unveiled at the Triennial Congress of American Physicians, to be held in Washington in May. The statue will be in the grounds of the Smithsonian Institution, near the Army Medical Museum.

THE deaths are announced of Mr. G. F. Schacht, who made improvements in the application of certain drugs to the treatment of disease, at the age of seventy-three years; of Dr. Liugi Calori, professor of anatomy at Bologna, at the age of eighty-nine years, and of Mr. R. Warner, an English horticulturalist, at the age of eighty-two.

THE Chemical Society of Washington, at its thirteenth annual meeting, elected the following officers: President, W. D. Bigelow; Vice-Presidents, H. N. Stokes and Peter Fireman; Secretary, V. K. Chesnut; Treasurer, W. P. Cutter, and Executive Committee, C. E. Munroe, E. A. de Schweinitz, Wirt Tassin and W. G. King.

COLONEL CARROLL D. WRIGHT, United States Commissioner of Labor, has been chosen President of the American Statistical Association, at its annual meeting. The position was left vacant by the death of General F. A. Walker, who had filled it for fourteen years.

DR. G. H. SAVAGE has been elected President of the Neurological Society of London. The subject of his inaugural address, which was to have been given on January 14th, is 'Heredity in the Neuroses.'

THE London correspondent of *Garden and Forest* states that the Royal Horticultural Society continues to provide lectures for its bimonthly meetings at the Drill Hall, and that the bulk of them are a success. Next year's program contains some items of more than usual interest, namely: 'Microscopic Gardening,' by Prof. Marshall Ward, of Cambridge; 'Artificial

Manures,' by Mr. J. J. Willis; 'Diseases of Orchids,' by Mr. G. Massee, F.L.S., of Kew; 'Physiology of Plants,' by Prof. S. H. Vines, of Cambridge; 'Mutual Accommodation between Plant Organs,' by Prof. G. Henslow; 'Roots,' by Prof. F. W. Oliver, and 'Sporting in Chrysanthemums,' by Prof. Henslow. In addition to these scientific lectures by eminent specialists, there will also be lectures upon practical subjects by leading practitioners. These lectures are all published afterwards in the Society's journal. The great exhibition at the Temple is announced for May 26th, 27th, 28th, and the exhibition of fruit at the Crystal Palace for Sept. 30th and Oct. 1st and 2d.

At the close of the thirtieth volume of *The American Naturalist* Prof. J. S. Kingsley, of Tufts College, and Prof. C. O. Whitman, of the University of Chicago, withdrew from the board of editors. Dr. F. C. Kenyon, of Philadelphia, takes the place of Prof. Kingsley as managing editor, with Prof. E. D. Cope. The *Naturalist* has, in its long history, witnessed unparalleled advances in the biological sciences, and will continue to be an important factor in the further progress that is assured.

Die Umschau is the title of a new weekly journal, devoted to pure and applied science, literature and art, published at Frankfort by Bechhold, and edited by Dr. J. H. Bechhold. The journal proposes to give a complete and reliable review in plain language of the advances in all the sciences. The first number includes articles by William Huggins on the physics of celestial bodies; by T. H. Achilles, Max Buchner and J. W. Bruinier on anthropological subjects, and by Prof. Eulenberg on the treatment of neurasthenia.

The *Journal of Nervous and Mental Diseases*, New York, will hereafter be edited by a board consisting of Dr. Charles L. Dana, Dr. F. X. Dercum, Dr. Philip Coombs Knapp, Dr. Chas. K. Mills, Dr. Jas. J. Putnam, Dr. B. Sachs and Dr. M. Allen Starr, with Dr. Ph. Meirowitz and Dr. Wm. G. Spiller as associate editors and Dr. Charles Henry Brown as managing editor.

The Macmillan Company announces as in preparation an *Encyclopædia of American Horticulture*, to be edited by Professor L. H. Bailey.

The Agricultural Appropriation Bill was presented to the House of Representatives on January 13th, by Mr. Wadsworth, Chairman of the Committee on Agriculture. The total appropriation recommended is $3,152,752, an increase of $102,780 over the amount appropriated for the current year. The increase is chiefly for the Bureau of Animal Industry, to be used in the inspection of meat. $120,000 is appropriated for the purchase and distribution of seeds, and the Secretary is directed to expend the appropriation. It is well known that Secretary Morton is opposed to this expenditure, and the item has been inserted in the bill without his sanction.

Mr. Chas. D. Walcott, Director of the U. S. Geological Survey, has asked for an immediate appropriation of $25,000 for the preparation of a map of the gold and coal areas of Alaska.

The Massachusetts Board of Agriculture has submitted to the General Court the report of the Gypsy Moth Commission. Mr. C. H. Fernald, the entomologist of the Board, recommends that $200,000 be granted for the work, and holds that if this appropriation be given for five years, with a smaller appropriation for ten years more, the pest can be exterminated. It can be held in check for $100,000 annually. If nothing is done the moth will spread rapidly in Massachusetts and elsewhere, and will cause great destruction.

Botanists and zoologists will learn with interest that a Biological Survey of Alabama has been organized and put into operation. The survey will be carried on under the auspices of the Alabama Polytechnic Institute, and will be manned by the specialists engaged at that institution in the various lines of biological investigation. It will have for its object the study in field and laboratory of all plants and animals occurring in the State, and of the various conditions affecting them. The work will be done sytematically and thoroughly and all results published. In a region so interesting and little known as this portion of the Southern United States, careful and extended research will be sure to yield results of great value.

Large quantities of material in all groups of plants, and animals (especially insects), will be collected and properly prepared. In connection with the survey there has been founded an Exchange Bureau, from which will be distributed all duplicate material. Those desiring to correspond relative to specimens, literature, or the work of the survey, should address: *Alabama Biological Survey, Auburn, Alabama.*

REUTER'S Agency is informed that Mr. Moore, of the Royal Society, has returned from Tanganyika. Mr. Moore was sent out by the Society early in 1895 to examine the fauna of Lakes Nyasa and Tanganyika. On account of the remarkable specimens of jelly-fish which have been sent home at different times by Mr. A. J. Swann and Captain Hore, the idea was formed that Lake Tanganyika must have once had some connection with the sea and still retained its partially marine fauna. Mr. Moore's researches completely confirm this view. The explorer is stated to have found not only remarkable marine jelly-fish and deep-sea fish, but also sponges in Lake Tanganyika. Mr. Moore will remain for about three weeks at Naples, in order to repack his collection before going on to London.

THE report of the Pasteur Institute for the quarter ending June 30th states that the total number of persons under treatment was 316, of which six died. Only twenty-three of the patients were foreigners.

A CHEMICAL laboratory has been fitted up in the top floor of the extension of the Boston State House, to be used by the State Board of Health for the analysis of water and other purposes.

THE London *Times* states that the Trustees of the British Museum have recently acquired, by purchase, a remarkable specimen, nearly 10ft. high, of the great extinct wingless bird, the moa (*Dinornis maximus*), from New Zealand. The intrinsic interest of this particular specimen rests on the ground that the skeleton is that of a single individual, unmixed with the bones of any other bird of the species. In this respect it is, indeed, extremely rare, not more than three, or at least four, similar examples being known. There are, of course, several other specimens of *Dinornis maximus* to be seen in the British and other museums, but these have all been reconstructed from bones belonging to more than one individual. The skeleton now at South Kensington was discovered by Captain F. W. Hutton, F.R.S., Curator of the Canterbury Museum, New Zealand, who, in conducting some excavations at Invercargill, Southland, came across the largest and most varied collection of moa bones ever obtained from one place, representing probably not fewer than 800 birds, none of them belonging to still living species.

IT is reported that motor carriages are to be introduced into New York in April by the New York Cab Company, compressed air being used to drive the carriages. The Hackney Vestry, London, is considering the use of motor vans and carts for watering the streets, collecting garbage, etc.

ELABORATE arrangements are being made for the International Horticultural Exhibition which will be held in Hamburg from May 1 to September 30, 1897. Besides a general permanent exhibition, outdoor and indoor, open throughout the summer, arrangements have been made for special exhibitions of plants, etc., at different seasons. The permanent exhibition will consist of various classes of trees, shrubs, herbaceous plants, groups of plants, technical appliances, garden plants, preserved fruits, wines and dried flowers and grasses. The dates of the special exhibitions are as follows: (1) Spring exhibition from May 1 to 7, 1897, for plants in season; (2) First special exhibition, May 30th to June 3d, for pelargoniums, floral arrangements, early vegetables; (3) Second special exhibition, July 2d to 6th, for gloxinias and other bulbous plants, roses (cut flowers), cut flowers or twigs of trees and shrubs, floral arrangements (to consist chiefly of roses; (4) Third special exhibition, July 30th to August 3d, for begonias, carnations, cut flowers (dahlias, gladioli and carnations), fruit trees in pots; (5) Autumn exhibition, August 27th to September 5th, for plants in season in pots (groups, single plants, novelties, etc.), floral arrangements, vegetables; (6) Fruit exhibition, September 17th to 30th.

Mr. John Milne has recently advocated an earthquake survey of the world. He states that for $5,000 twenty observatories willing to co-operate can be provided with the necessary instruments, and calls attention to the important theoretical and practical problems that can thus be solved. One of the recent earthquakes in Japan was recorded about 16 minutes after its occurrence in Mr. Milne's observatory on the Isle of Wight, and showed that there had been an error in telegraphic transmission to the newspapers of two days, whilst another gave an accurate account of a catastrophe the details of which were not known until mails arrived some three weeks later. An absence of records from the Isle of Wight seismographs has on more than one occasion shown that telegrams have exaggerated seismic effects, and in one instance at least—referring to a recently reported disaster in Kobe—indicated that the sender, regardless of the alarm he might create, was without foundation for his widely-published message. The immediate benefits derived by observatories at which instruments were installed, over and above the speedy announcement of great catastrophes in distant places, would be that the records of earth movements would throw light upon some of the otherwise unaccountable deflections shown in diagrams from magnetographs, barographs and other instruments sensible to slight displacements, whilst diurnal and other changes in level affecting astronomical observations would be countinuously recorded.

Mr. Bennett, who is acting as British Consul-General at Galatz, has prepared, says the London *Times*, a report on the petroleum industry in Rumania, where, he thinks, it is likely to play an important part in future commercial development. Petroleum exists in abundance in Rumania, in the zone stretching from Turn-Severin, on the western frontier, along the foot of the Carpathians, towards Bukowina and Galicia. It is found throughout the whole of this region, but especially in the Olt, Dimbovitza, Prahova, Buzeu and Tazlan valleys. It is said also to be found in the whole of the plains down to the Danube. There are about fifty borings and eight hundred wells dug by hand in the five districts above mentioned; but these are all shallow, and the output in 1894–95 reached 800,000 tons. Although petroleum has been worked in Rumania for 25 years, the industry is evidently in its infancy still. The greater part of the land is owned by the state and large holders who reside in the towns and will not invest money in industrial enterprise; grain has monopolized the energy and capital of the Rumanians, and the forests and mineral wealth of the country are neglected. Thus it was not until 1895 that a mining law was passed, and up to that date the ownership of land below the surface had never been determined. Nor is there a body of native mining engineers. About a third of the crude oil is taken from the wells of four firms, while the remainder comes from the workings of numerous small proprietors, who heve not the capital necessary for proper development of the deposits.

UNIVERSITY AND EDUCATIONAL NEWS.

The Johns Hopkins University has published the twenty-first annual report of President Gilman. The report itself, presented to the trustees on November 21st, extends to sixteen pages only, but there are two appendices. One of these contains the reports on the chief branches of study prepared by the principal instructors in the several departments, together with statements regarding the library, the press, the State Weather Service, The State Geological Survey and the marine laboratory. In conclusion there is given an interesting retrospect of the twenty years now completed by the University. The important service performed by the Johns Hopkins University for education and science in America is adequately witnessed by the fact that nearly half of its students have become teachers. The following institutions have on their staff more than ten students from the University: Johns Hopkins University (67), Chicago (23), Wisconsin (19), Bryn Mawr (18), Leland Stanford, Jr. (17), Michigan (17), Pennsylvania (16), Cornell (14), Columbia (13), Massachusetts Institute of Technology (11), Nebraska (11), Northwestern (11), Harvard (10), Woman's College of Baltimore (10).

The faculty of the Massachusetts Institute of

Technology, on January 13th, elected Professor James M. Crafts, of the chemistry department, chairman *pro tem.* of the faculty, pending the election of a successer to the late Gen. F. A. Walker as President.

MR. G. A. HOBART, Vice-President elect, has given $5,000 to Rutgers, of which he is a graduate.

DISCUSSION AND CORRESPONDENCE.

A NATIONAL DEPARTMENT OF SCIENCE.

TO THE EDITOR OF SCIENCE: I have just seen in the current number of SCIENCE Dr. Dabney's discussion of this subject, and, feeling that the natural inferences most persons unacquainted with government work would draw from it, must be not only inaccurate but mischievous, I feel obliged to point out that there are at least two sides to the question, and it is extremely doubtful whether the establishment of such a department would be beneficial to science, economical or efficient to a degree warranting the change.

With much that Dr. Dabney has written I am in accord; it is his conclusions, and the inferences to be drawn from his manner of presenting the facts, that demand further examination.

It is nothing new for people to assume that the proposal of a new set of well chosen names, a new classification of well known facts, or a cleverly drawn scheme of organization of previously distinct agencies, has in itself added something to knowledge, or possesses an inherent power of some undefined sort to make things easier, cheaper or better. Such assumptions are at the basis of nearly all cranky theories, as well as occasional good ones. No scientific man should accept such hypotheses without a thorough investigation of the facts.

I take it that the object of a scientific bureau is to gather, digest and disseminate facts in regard to matters with which it is officially charged. If this work is done promptly, efficiently and accurately, at a reasonable cost, the bureau justifies its existence, and not otherwise. It is of no consequence, whatever, to the bureau and its work whether it is attached to one department or another, or to none, if the bureau is conducted by a competent person on scientific principles, and with a view simply to getting the best possible results. The origin and success of our scientific bureaus has been due, as Dr. Dabney points out, to the fact that they are, in the main, the crystallized result of individual effort exerted in a particular field and with the object of attaining certain definite ends.

The men to whom we owe our best scientific agencies under government, worked, and often gave their lives prematurely, not to get offices, or titles, or salaries, or to add a new name to the lists of bureaus in the blue books, but to promote research and benefit the nation by its results. This, too, has been the object of their successors in conscientious devotion. The danger and difficulty which has threatened the bureaus, and never more than at the present time, has been the intrusion of politics or personal interest in appointments, and the stifling of individual initiative by an excess of red tape, imposed generally in good faith by Congress with the idea of preventing abuses.

From Dr. Dabney's account it might be supposed that a number of bureaus were, to a greater or less extent, duplicating each other's work, and the inference is direct from his argument that this duplication might and should be prevented by a consolidation of the various bureaus. The supposition is, I believe, quite erroneous and the inference wholly fallacious.

The bureaus exist to do work, and the advisability of any change in organization must be measured by its capacity for increasing results, improving efficiency, and promoting economy without lessening the product measured in results. If consolidation would diminish results, impair efficiency, and do away with individual responsibility to any marked degree, it would be dearly bought. That this would be the case, under present conditions, there can be hardly any doubt; and the coolness with which the proposition, which is by no means new, has been met in Congress is, I am convinced, due to the fact that the more influential members, as good business men, recognize that the hypothesis is without the essentials of a workable scheme.

At present most of the bureaus are attached to some department. The head of that department has many divisions to supervise. In general, even if not specially interested in science

he is a man of broad views and good executive capacity. After satisfying himself that the proper official safeguards are observed in the bureau and that the head of it is competent and of good report, the Secretary rarely meddles with details—in fact, has no time to waste upon them.

The Director of the bureau can devote his energies to carrying on its work and maintaining proper supervision of details. If it is a bureau in which, say, chemical work is required, the laboratory occupies part of the quarters of the bureau, its operations are immediately adjacent to the offices of men whose work is being supplemented by chemical research, the supplies for the chemist are only those required for the work he is doing, and the latter is promoted by the constant opportunity of conference between the people interested. An experiment can be ordered, immediately taken up, the process altered or the scope enlarged while actually in progress, or it can be stopped to take up something of instant importance; in short, the laboratory is a tool in the hands of the bureau, which can be directed to exactly the work which is required without delay, interruption or interference. This promotes efficiency and the progress of science.

It is true that an unfriendly Secretary might wreck the scientific work of a bureau by getting rid of a competent and installing an incompetent Director. But this danger is not obviated by the suggested consolidation, and cannot be by anything short of a cordial acceptance of the merit principle of civil service reform by the whole executive body of the government. We are all agreed that that will be a happy day, but also that it has not yet dawned.

The head of the proposed department is to be a Cabinet officer, and hence necessarily changed with the changes of administration. It follows that he will be more or less of a politician and his appointment obtained by political methods. Having no other executive duties, and it being impossible that he should have a working knowledge of all of the scientific branches under his control, the tendency to meddle and modify would be almost irresistible. The Directors of the several bureaus, instead of attending to their business, would have to occupy themselves in protecting it against ill-advised interference.

The chemical laboratories being consolidated, the chief chemist would be a greater man than any of his colleagues. No Director of a bureau could control his own chemical work. With demands for particular jobs from several bureaus on hand it would be wholly uncertain when any of them would be finished. Complaints would be met by playing one off against another. Responsibility, and, to a large extent, efficiency, would be lost. Meanwhile no fewer men could do the chemical work than were required before. Instead of the quarters being included in the rent of the several bureaus, as now, a large and separate building would be called for and required. That a dollar would be saved by such a proceeding is doubtful. That delays and inefficiency would be inevitable is certain. It may be said that the above is a pessimistic view, but we have in the government printing office a brilliant example of the effects of consolidation, where it takes six months to a year to get a scientific book printed, and there is no responsibility whatever to the Department, whose work is entirely at the mercy of the public printer, who knows no superior and does as he likes. Those who have had experience with his office do not desire any further consolidations of the same kind.

Of course, the chemical laboratory has been merely taken as an illustration. The writer has nothing to do with such laboratories, but the principle holds good throughout.

Dr. Dabney has spoken of other instances of supposed duplication of work, or rather two parties doing the same kind of work. Any genuine duplication could be cured at once if pointed out, but, as before stated, the duplication is not real but nominal. Different sorts of work are called by the same name. There is no point of contact between the hydrology of the Geological Survey and the hydrography of the Navy Department. Methods which would disgrace the Coast Survey work have always been regarded as entirely sufficient in the Land Office. One kind costs twelve cents a mile, the other two hundred dollars. These are not duplications.

I do not for a moment claim that our govern-

mental methods are perfect, or that well considered changes may not in some cases be wholly desirable. All I desire to do is to point out that the nostrum now offered is by no means a cure-all, and that the attainment of ideal conditions depends almost wholly on an honest recognition by the whole country, as represented by Congress and the executive, of merit, fitness and resulting permanency of tenure in the staff of the scientific bureaus.

WASHINGTONIAN.

WASHINGTON, January 16, 1897.

THE JURASSIC WEALDEN (TITHONIAN) OF ENGLAND.

PROF. O. C. MARSH has called again attention to the Wealden formation of England—an abnormal deposit, rather puzzling. Every observer working at geographical geology and general classification has been struck by an enigma in the otherwise classical classification of the strata of England. Between the Portland stone at the island of Portland and at Durstone bay, and the Lower Greensand of the Middle Cretaceous, we have a series of beds, mainly sands and clays, with some limestone and dirt in the inferior part, which has been called a fluvio-marine and fresh-water formation, of a thickness of about 1,500 or 2,000 feet, designated generally by the name of Wealden. The name of 'Weald formation, or Wealden,' was first introduced in the English classification by P. I. Martin in 1828 (*A Geological Memoir on a Part of Western Sussex*, p. 40, 4to, London).

Dr. William H. Fitton accepted it, and in his celebrated memoir, *Observations on some of the strata between the Chalk and the Oxford oolite in the Southeast of England*, Trans. Geol. Soc. London, second series, Vol. IV., p. 103, London, 1836, gives a detailed account, dividing the Wealden into three great groups, called the Purbeck strata, Hastings sand and Weald clay proper.

Dr. Gideon A. Mantell is generally credited as the author of the stratigraphic position in English classification of the Wealden formation (*Illustrations of the Geology of Sussex*, 4to, London, 1827, and *A sketch of the Geological structure of the Southeastern part of Sussex*, Lewes, 1818). He puts it as the lowest part of the Cretaceous formation.

The classification of Mantell was generally accepted until November, 1849, when Edward Forbes observed at Portland and Swanage that Fitton and Mantell made mistakes, especially in regard to the Purbeck marble series, and, after some close and excellent observations, recognized that the Purbeck was Jurassic and not Cretaceous. As he humorously says in a letter to Ramsay: "The 'geology of England' may be 'done' by the old fellows, but it is not overdone yet." (*Memoirs of Edward Forbes*, p. 461, London, 1861.) Edward Forbes was the man to correct errors of classification in regard to the Mesozoic and Tertiary. He has no equal for sharp observations and correct conclusions. Unhappily he was not able to finish his work; his premature death in 1854 arrested completely the researches he inaugurated so well in Dorset and the Isle of Wight. Even his work, as he has entitled it, 'A Description of the Purbeck and Wealden fresh-water and fluvio-marine strata of Dorsetshire and the Isle of Wight, with comparative remarks on synchronous strata elsewhere' (Preface, p. vii., *On the Tertiary fluvio-marine formation of the Isle of Wight*, London, 1856), was never published; only a short notice was given to the public in the British Association Report for 1850, under the title 'On the succession of organic remains in the Dorsetshire Purbecks.' However, short as it is, the notice of Forbes brought the age of the Wealden once more before the English geologists, and one of them who knew best the Secondary or Mesozoic formations, the nephew of the celebrated 'Strata Smith,' Prof. John Phillips, of the University of Oxford, in his remarkable *Manual of Geology*,* pp. 282–318,

* Extract from a letter of Prof. John Phillips to Jules Marcou. * * * "As to the propriety of placing the Wealden in the Cretaceous I have my doubts. Certainly the fresh-water fossil remains, which otherwise are not characteristic of the age of strata, are not in favor of uniting the upper part of the Wealden with the Cretaceous, while the *Megalosaurus* and other Saurians, as well as the fishes and plants found in the Middle (Hastings Sands), protest loudly against the separation of the Wealden from the Oolites." JOHN PHILLIPS.

ST. MARY'S LODGE, YORK, July 23, 1887.

London, 1885, has placed the Wealden formation with its three groups—Purbeck beds, Hastings sand and Weald Clay—into his Oolitic (Jurassic) system.

This classification of John Phillips was not accepted by the Geological Survey of England and the Director-General, the late Sir Andrew C. Ramsay, in his excellent book, '*The Physical Geology of Great Britain*,' fifth edition, pp. 201–212, London, 1878, classifies the 'Purbeck and Wealden strata,' as Lower Cretaceous, saying that the Hastings sands and Weald clay are the fresh-water equivalents in time of the lower and middle part of the Neocomian of Switzerland; adding, 'an assumption' which 'is undoubtedly correct.' Such correlation is inacceptable, for paleontology, lithology and even stratigraphy are wanting entirely, and an 'assumption' cannot replace principles and rules of classification.

Meantime, the true Neocomian has been found in Yorkshire, northwest of Flamborough Head, near Speeton, and described with details and exact correlations by Prof. J. W. Judd in 1868 and 1870, and more recently by Mr. G. W. Lamplugh in 1889 and 1892. Prof. A. P. Pavlow, of the University of Moscow, first in collaboration with Mr. Lamplugh in 1892, and afterward alone in his paper, *On the Classification of the Strata between the Kimmeridgian and Aptian* (Quart. Journ. Geol. Soc., London, Vol. 52, pp. 542–554, London, April, 1896), has given correlations of the Wealden with the Speeton clay and Neocomian of western Europe and Russia. Prof. Pavlow places the Purbeck beds in the Jurassic formations and regards them as the equivalent of the Tithonian of southeastern France.

Now comes the paper of Prof. O. C. Marsh, first read in 1895 at the British Association at Ipswich, and afterward at the National Academy of Science, New York, meeting November, 1896, in which he says that on the vertebrate fauna the Wealden is Jurassic and not Cretaceous.

Many years ago Louis Agassiz had referred some fossil fishes from the Purbeck of England to species of the upper Jura of Switzerland and France. Lately Mr. Smith Woodward, according to Prof. Marsh, has found that the fossil fishes of the Wealden are of Jurassic types; and finally the paleobotanist, Mr. A. C. Seward, after a review of the Wealden plants, says that the evidence is in favor of 'the inclusion of the Wealden rocks in the Jurassic series.' Accordingly, the opinion of Prof. John Phillips, expressed as far back as 1855, is now indorsed by the reptilian fauna, by the fishes and by the fossil plants. Such a concourse of paleontological proofs must correspond with some geographic and stratigraphic facts in the districts of eastern England extending from the island of Portland to Speeton and Filey Bay, in Yorkshire.

During a prolonged visit at Weymouth, in 1870, I was surprised at the small thickness of the Portland stone (only 8 feet) in the celebrated Portland quarries, and at the great development of the Purbeck beds covering the whole Island. As far back as 1858 (*Sur le Néocomien dans le Jura*, etc., Genève) I called attention to the correlation of the Purbeck beds with what was called in France 'Calcaires Portlandiens,' or 'Calcaires de Salins' of Franche-Comté. Since those Portlandian limestones of the Jura have been studied with more detail and exactness in regard to their thickness and the fossils found in them, it is now certain that they constitute a group of strata all younger than the Portland stone of the isle of Portland. The latter are correlated and identical in every way with the 'Marnes Portlandiennes' or 'Marnes de Salins,' containing exactly the same fauna with its most characteristic fossil, the *Exogyra virgula;* and we have now an indisputable horizon, common to southeastern England and France, the Portland stone and the 'Marnes Portlandiennes,' or 'Marnes de Salins,' or zone of the *Exogyra virgula*.

In England before reaching the Speeton clay, undoubtedly Neocomian or Lower Cretaceous, we have above the Portland stone, the three groups of the Purbeck beds, the Hastings sand and the Weald clay. In the Jura Mountains, above the 'Marnes de Salins' with *Exogyra virgula*, we have the 'Calcaires de Salins,' or Portlandian limestones, composed of two groups; the inferior called: 'Portlandien inférieur,' containing a rich fauna, such as: *Nerinea Salinensis*, *Nerinea grandis*, *Natica Mar-*

cousana, Natica Athleta, Trigonia Barrensis, Trigonia Boloniensis, Mytilus portlandicus, Mytilus Tombecki; and finally the *Hemicidaris Purbeckensis* of Forbes. The second group at the very top of the Jurassic formation, called in Franche-Comté 'Dolomies portlandiennes' of Marcou (*Etudes géologiques sur la Franche-Comté septentrional, Le système oolitique*, par Albert Girardot, p. 369, Paris, 1896), contains also a special fauna, indicating at some places a brackish formation, such as: *Corbula, Anisocardia, Cyrena, Protocardia, Lucina, Corbicella and Gervilliana.* However, at Gray (Haute Saône) the fauna is entirely marine, and Prof. Etallon, who has given a detailed description of that portion of Franche-Comté, has called it 'Diceras Portlandian beds.' In both divisions, or groups, corals are common round Gray, Morteau, Pontarlier and Salins. The thickness of the two groups varies between 150 and 600 feet, according to the more or less denudation of the upper portion of the strata.

Prof. Albert Oppel, of Munich, had created, in 1865, his Tithonic, or Tithonian formation (*Die Tithonische Etage*, Zeitschr. deutschen geologischen Gessellschaft, Jahrg, 1865, pp. 535–558, Berlin) to designate a special form of the divisions of the upper Jura, such as the Purbeck strata, the Solenhofer Schiefer and the Portland kalk, of the Alpine area and of the Mediterranean basin; it was a happy name, meaning that the groups of beds containing paleontological precursor forms of the Cretaceous fauna can be considered as a forerunner formation, announcing the arrival of another great system. Many papers have been published since the premature death of Oppel, in November, 1865, on that important question, the most remarkable being by Colonel A. Toucas, entitled '*Etude de la faune des couches tithoniques de l'Ardèche*' (Bull. Soc. Géol. France, 3d series, Vol. XVIII., pp. 560–629, Paris, 1890), in which he showed the existence of three different faunas, called Lower Tithonic or Diphyakalk, Middle Tithonic or Ardescian, and Upper Tithonic or Berriasian-Puberkian.

In England nothing can be correlated with those six hundred feet of limestone deposited in the Jurassic sea of southeastern France, of the Swiss Alps, of the Tyrol, of Stramberg (Carpathes), of Andalusia (Spain), but the brackish and fresh-water deposits of the Wealden formation. At Speeton there is nothing like it. The Portland stone is lacking there, very likely destroyed by denudation, and the series of Speeton clay is decidedly Neocomian, as it has been amply proved by Messrs. Judd, Lamplugh and Pavlow. If we consult the geological map of England, we see that directly over the small Portland beds, only eight or ten feet thick, we have brackish and fresh-water deposits, at first containing a few marine beds with the *Hemicidaris Purbeckensis* of Forbes, then becoming exclusively fluviatile, extending southward of Dorsetshire and the Isle of Wight, turning northward in the English Channel, reaching again the *terra firma* at Hastings and its environs, covering in the form of a cut ellipse all the country of the Weald, between the North Downs and South Downs (Kent and Sussex counties). We have there a sort of gigantic fossil mound, the remnant of a great delta or estuary deposit, like those actually going on at the mouth of the Ganges or of the Amazon. Farther west than the Weald region that formation lies directly over the Portland stone in the vale of Wardour, and very likely it extended northward. At the end of the Jura epoch the dislocation which has emerged the Jura formation in England and on the continent of Europe put a stop to those fresh-water deposits, and, being emerged as dry land, denudation began to remove easily such loose materials as clay and sands, leaving only the large semi-elliptical patches of southeastern England. The denudation lasted as long as the Neocomian or Lower Cretaceous deposits were going on at Speeton and in France and Switzerland; then by a general subsidence, affecting the whole coast of eastern England, the sea of the Yorkshire coast invaded the whole country south, depositing on the beds of the Wealden formation, and in some parts over the beds of the Portland stone and Kimmeridge clay, the strata called Lower Green Sand, Gault, Upper Green Sand and Chalk. The proof that the green sand sea came after the denudation, and even complete removal in some places of the Wealden, is shown by the existence of Lower Green Sand west of Hastings, lying directly on the

Hastings sand, when generally it lay always on the Weald clay.

The change effected on land and sea areas at the end of the Jura period was on a very grand scale in Europe as well as in America; and the Neocomian or Lower Cretaceous was not deposited in many portions of central Europe, especially in England, except at the little corner of Speeton, on the Yorkshire coast; and in the United States the Neocomian, even more limited than in Europe, was confined to Texas, the Indian Territory and southern Kansas.

One word of explanation on the use in France and Switzerland of the name 'Puberckian,' to designate the upper Tithonic or Berriasian. From the beginning, in 1848 and 1859, I showed that the name was wrongly applied to strata much younger than the Purbeck beds of England. The position of the *Hemicidaris Purbeckensis*, found in the first beds of the Salins limestone, authorize the correlation of the Puberckian of England with the base of the calcaires porlandiens or Lower Tithonic of the Jura. And the Purbeckian of the Jura Mountains, so well described by Gustave Maillard in his well known monograph (*Mém. Soc. Paléont. Suisse*, Vol. XI., Genéve, 1884), correspond and is the equivalent of the lower portion of the Spilsby sandstone of Lamplugh and Pavlow; it is to say, it represents in the Jura the base of the Speeton clay of England, instead of being correlated to the Purbeck beds of the Island of Portland.

CORRELATION OF THE ENGLISH AND EAST FRENCH FORMATIONS.

	England.	*Eastern France.*	
Speeton.	Tealby limestone.	Urgonian or Upper Neocomian.	Neocomian.
	Tealby clay.		
	Claxby ironstone.	Hauterivian or Middle Neocomian.	
	Spilsby sandstone.	Valengian or Lower Neocomian.	
	Weald clay.	Jura—Portlandian limestone.	
	Hastings sands.	Ardéche—Upper, Middle and Lower Tithonic.	
	Purbeck beds.		
	Portland stone or *Exogyra virgula* zone.	Portlandian marls or *Exogyra virgula* zone.	

The correlation of the Wealden of England with the Tithonic of Franche-Comté, Switzerland, Savoy, Dauphiné, etc., is a beautiful work awaiting the careful researches of English geologists, and it is to be hoped that Mr. George William Lamplugh, now on the staff of the Geological Survey, who has done such good service at the geology of Speeton, will continue the work so well begun forty-eight years ago by Edward Forbes, so well traced in 1855 by John Phillips, and now so well advocated by Prof. O. C. Marsh.

Jules Marcou.

Cambridge, January 1, 1897.

COMPLIMENT OR PLAGIARISM.

The carefully prepared reply of Professors Beman and Smith (Science, p. 61) is disingenuous. Professor Halsted would gladly have printed in parallel columns the whole of his section, *Partition of a Perigon* (Elements, 151), which reappears in Beman and Smith, p. 179, as 'Partition of *the* Perigon.' As I made this section myself, I feel safe in asserting that it never before occurred in any geometry in the English language; but how could I ask the editor of Science to reprint it simply because Professors Beman and Smith had reprinted it? They deliberately say, "the *order* of the problems: To bisect a perigon, to trisect a perigon, to cut a perigon into five equal parts, to cut a perigon into fifteen equal parts," etc., "may be found in Newcomb's Geometry." (Science, p. 61.)

With Newcomb's book now in my hand, I assert that not one of these problems occurs therein. Next they assert that the word 'perigon' is 'found in several geometries.' If, in English, they mean Halsted's Metrical Geometry, 1881; Halsted's Elements, 1885; Halsted's Elementary Synthetic, 1892; Beman and Smith, 1895. The statement is disingenuous. If they knew of any other they would have named it.

George Bruce Halsted.

THE METEOROLOGICAL CONFERENCE AT PARIS. A CORRECTION.

On page 17 the last sentence of the first paragraph of my report should read as follows: "No one came from either Spain or Brazil, as was not the case at Munich, but Italy, Belgium, Canada and Mexico each sent a delegate to Paris, the two latter countries participating for the first time in an international meeting."

I desired to state briefly the principal countries which were represented at Munich and not at Paris, and *vice versâ*, but I might add that, although representatives from both Austria and Russia came to Paris, yet there was much regret at the absence of Prof. Hann, the eminent director of the Austrian Meteorological Bureau, and of Prof. Wild, late director of the Physical Central Observatory at St. Petersburg, both of whom had taken an active part in these international meetings since the first conference at Leipzig in 1872.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY, January 6, 1897.

THE STUDY OF FEAR.

EDITOR OF SCIENCE: One sentence in your account of Prof. Stanley Hall's study of fear has especially attracted my attention: "The fear of high places, President Hall thinks, is a vestigial trace, like the gill slits under the skin of our necks, antedating limbs and inherited from our swimming ancestors." A study of fear by the comparative and genetic method seems called for if results are to rest on a sure and broad foundation. In my own investigations on the psychic development of animals the subject has not been overlooked. I have called attention to a peculiar manifestation when even the youngest mammals and birds are placed near the edge of a surface that is elevated; but I have also pointed out that a turtle will walk off any such elevated support again and again, and, as is well known, a frog will jump almost anywhere, so that, if I understand Dr. Hall aright in the above sentence, these facts seem to present a difficulty in the acceptance of this part of his theory.

WESLEY MILLS.

MCGILL UNIVERSITY, MONTREAL.

GLOSSOPHAGA TRUEI.

TO THE EDITOR OF SCIENCE: In the Proc. U. S. National Museum, Vol. XVII., No. 1100, I described a new species of bat under the name *Glossophaga villosa*. But a *Glossophaga villosa* was described by Rengger (Naturgesch. der Säugeth. von Paraguay 1830, 80). I, therefore, rename the new species. I propose the following: *Glossophaga truei*, after Mr. Frederick W. True, the accomplished curator of Mammals at the Museum.

HARRISON ALLEN.

PHILADELPHIA, PA., January 13, 1897.

SCIENTIFIC LITERATURE.

Étude de Huit Essais de Machine à Vapeur. Par V. DWELSHAUVERS-DERY. Extrait de la Revue Universelle des Mines, t. XXXVI., 1896.

Mon. Dwelshauvers-Dery has published recently a report on the work of his laboratory, on his experimental engine, relative to the efficiency of the machine under various conditions, mainly affecting the quality of steam supplied.* He supplements that report, in the article here referred to, by a more complete study of these effects, and with extended illustration of his methods of conducting the work and of giving instruction in this department. He describes the conduct and computation of eight engine-trials, four with saturated and four with superheated steam. His conclusions from the preliminary study have already been given.†

Dwelshauvers is a consistent follower of Hirn, whose 'practical' or applied theory of the steam-engine he has developed, giving it algebraic expression and establishing seven principal equations by means of which he is enabled to compute essential data from the results of observation during an engine-trial. These expressions and their derivation are given in the report here under review. His graphical illustrations of the method of distribution and of variation of thermal and of dynamic energies in the cycle studied, and their interconversion, afford a means of bringing clearly before the investigator and the student the essential facts of engine-operation, in each case, and throw into high relief the most important phenomena.

They show clearly how great is the quantity of heat-energy exchanged between steam and cylinder-wall, and bring out plainly the fact that this waste is enormously less with superheated than with saturated steam. They show that the use of the steam-jacket is 'but a palliative, not a radical and complete remedy' for this waste. The steam-jacket, while almost invariably reducing wastes, nevertheless itself

* *Revue Universelle des Mines*, t. XXXIV., 1896.

† SCIENCE, N. S., Vol. IV., No. 89, p. 654.

wastes a large part of the heat which it transmits to the working charge; transmitting it through the cylinder-wall too late in the stroke to be of much service, or even so late as to be absolutely lost by passage into the cylinder during the period of exhaust, instead of, as necessary for best results, early in the induction period. Both in using the steam-jacket and in superheating, the reduction of the waste by initial condensation fails to give commensurate gain in work performed by the unit weight of steam. In one instance, for example, a reduction of initial condensation by ten per cent. only gave increase of work to the extent of two and a-half per cent. In another instance a reduction of wastes by twelve per cent. gave a gain of work of only three per cent. The action of superheated steam is more favorable, and the gain in work done and increased efficiency amounts to more nearly one-half the percentage of reduction of wastes by initial condensation.

The steam was condensed in a surface-condenser. The mean quantity of steam condensed per hour and per square meter was 13 kgs. The mean quantity of heat abstracted per kg. of steam was 567.7 calories. The mean quantity of heat traversing the condensing surfaces was 7,402 calories per hour and per square meter. The cylinder-heads transmitted nearly twice this quantity from their jackets into the cylinder, and the cylindrical jacket of the cylinder proper about one-fifth as much as the transmission into the condenser.

'Cylinder condensation,' during the brief period of its action on this engine, occurred at the enormous rate of 494,600 calories per hour hour and per square meter—seventy times as rapidly as in the surface condenser—and illustrates the most rapid transfer of heat known to the engineer or the man of science. Mon. Dwelshauvers is probably the first to measure this figure with any degree of accuracy, though Cotteril, long ago, gave us the general facts and approximate computations.

A very important and, to the experimenter, an unexpected, development was, as stated by him, the following: "With steam superheated to 166° C. at its entrance into the engine, and with saturated steam at 155° C. stagnant in the jackets, the use of the jacket gave an economy of 20 per cent. and over by reducing the initial condensation."*

The fact is now incontestable and it is easily seen that, so long as the action of the superheated steam is not such as to completely extinguish initial condensation by bringing the temperature of the cylinder wall fully up to that of the saturated boiler steam, the jacket may still find opportunity to reinforce the action of the superheated steam by doing some work in the interval between the instant of closing of the induction valve and that of its reopening in the succeeding cycle.

These contributions to our knowledge of the interior workings of heat and steam in the engine will undoubtedly be received as among the most important yet placed on record in the history of the experimental investigation of the steam-engine, and M. Dwelshauvers-Dery, through these researches, as an earnest and worthy disciple and successor to Hirn, will earn an enviable distinction. R. H. Thurston.

Cornell University.

Prehistoric Man and Beast. By Rev. H. N. Hutchinson, B. A., etc. Illustrated. D. Appleton & Co. 1897. pp. 298.

Mr. Hutchinson, already known to the readers of general literature by his works, 'Extinct Monsters,' etc., has endeavored, in the present volume, to present, in equally popular style, some of the latest results of geology and archaeology with regard to primitive man.

He distinctly disclaims writing for special students in either of these branches, and also offers himself solely as an interpreter of the opinions of others, and 'not as a Brahmin.' Nevertheless, he espouses very warmly, and claims as quite decided, various opinions which the 'specialist,' if he is fair-minded, considers still undetermined. For example, he heads one chapter 'The Myth of the Great Ice Sheet,' and assumes as incontrovertible Sir Henry Howorth's contention that the ice sheet of glacial

*This fact was asserted by the writer some years ago and was challenged by various authorities, including M. Dwelshauvers, who has since given us these facts and has frankly reversed his position. *Vide* Manual of the Steam Engine (R. H. T.), Vol. I.; Secs. 145, 153, pp. 598, 697; and Trans. A. S. M. E., Nov., 1889; Journal Franklin Inst., Dec., 1889.

times did not exist; which is very far from securing unanimous consent among geologists.

In the same manner Mr. Hutchinson knows a great deal more about the antiquity of man than most geologists. He knows that the human species is at the most not more than 25,000 years old. Surely he has with him in that calculation the decided minority of scientific students. To most, such a period seems quite inadequate to account for known facts in human history, apart from geologic questions.

His book has ten quite pretty full-page fanciful illustrations, designed by Cecil Alden, of the *Illustrated London News*. They represent a courtship of a warrior of the bronze age, the building of Stonehenge by the dwarfs, etc. The dozen chapters into which his subject is divided take up the cave-dwellers and reindeer hunters of the stone age, the 'myth' of the great ice sheet, changes of climate, the antiquity of man, the men of the bronze age, the dwarfs and the stone monuments, as dolmens, etc.

In the line of popularizing science these chapters are moderately meritorious. The leading English works have been consulted, and especial respect is paid to such as do not oppose received and conventional opinions, or do so the least. Their writers are preferred by the author as the correct exponents of modern research. He makes considerable business out the seeming contradictions of testimony and the disagreements of specialists, when the facts do not suit him (*e. g.*, the Spy Man and the Pithecanthropus). His reports, therefore, while apparently judicial in tone, are not really so in spirit. They are probably tinged by his avocation, as is almost inevitably the case.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

Chemistry for Beginners. By EDWARD HART, Ph.D. Third Edition. Revised and greatly enlarged. With 62 Illustrations and 2 plates. Easton, Pa., Chemical Publishing Company. 1896. Small square 8vo. 245 pages. Price, $1.50.

In text-books of elementary chemistry we have one of the most prolific fields of scientific literature, and, so far from deprecating this fact, each new book is to be welcomed as a contribution toward the solution of the difficult problem how best to teach chemistry to beginners. This problem is as yet far from solution; still, comparing the text-books of to-day with those of twenty, or even ten years back, it is apparent that a distinct advance has been made. This at least may be considered settled, that a prominent place must be given to experimentation on the part of the student. What shall be the relative order of theory and description and the order of the elements in descriptive chemistry is as far as ever from a final word, nor will the latter point, in the opinion of the writer, be settled until a natural order dependent on the periodic system is reached. As regards the former point, it must be kept in mind that there are two classes of beginners—those studying in secondary schools and those of maturer minds in colleges; a method of treatment suitable for one would quite possibly not be best suited for the other.

The book before us is from the pen of an experienced teacher, and of this it gives abundant internal evidence, and while written for beginners in colleges is equally well suited for use in high schools and academies. Ostensibly a third edition, it is so completely revised and so much enlarged that it is virtually a new book. The order of treatment is as follows: Introduction on 'rusting' of metals, oxygen, hydrogen, water (with potability, purification, etc.), constitution of matter, atmosphere, compounds of nitrogen, carbon and its compounds, halogens, sulfur, silicon, boron, phosphorus, arsenic, the metals, the carbon compounds (sixty-six pages on organic chemistry).

The theoretical portion of the subject is taken up from time to time, under appropriate compounds or elements. While the elements are considered, for the most part in the usual groups, little or no regard is paid to the periodic law in their arrangement. Equations for reactions are very sparingly used, and the word valence seems not to occur at all, although graphic formulæ are used, especially in the portion on organic chemistry.

The strong feature of the book is in experimentation. Over two hundred experiments are described, and it would be difficult to find a book containing as many pertinent, well selected,

clearly described experiments, so well fitted to elucidate the text. Even experienced teachers can gain many useful points from this book. The introduction of quantitative experiments near the beginning is a great advantage, and one could wish that Prof. Hart had increased their number, were it not for the great practical difficulty of supervising a large class of novices in quantitative manipulation.

To another feature of the book attention is called in the opening paragraph of the preface: "In compiling the following pages I have tried to bear constantly in mind the fact that a large majority of those studying chemistry are not likely to become professional chemists, and have therefore taken pains to enlarge upon those topics which all educated persons should understand, such as water purification, fertilizers, the concentration of ores, the roasting of ores, assaying, the iron blast furnace, steel manufacture, etc." In these descriptions as well as in most other cases the book is up to date, and is remarkably free from portrayals of antiquated processes handed down from author to author, and so often found in modern text-books.

The book offers occasional opportunity for criticism. NO is so universally called nitric oxid or nitrogen monoxid that it is confusing to name it nitrogen dioxid; one can hardly say that 'chloric acid is *contained in* chlorates;' but points of this kind are few.

The book is attractively gotten up and the proof has been very carefully read. It should find entrance into many laboratories outside of that of its author.

Jas. Lewis Howe.
Washington and Lee University.

Die Chemie im täglichen Leben. Gemeinverständlichen Vorträge von Dr. Lassar-Cohn, Universitäts professor zu Königsberg in Preussen. Verlag von Leopold Voss, Hamburg und Leipzig. 1896.

This book consists of twelve popular lectures on chemistry delivered by the author before the 'Verein für fortbildende Vorträge' in Königsberg. The lectures cover a wide range of topics of interest to a popular audience and are presented in a very clear and forcible manner. Among the many subjects considered may be mentioned breathing, the weight and analysis of the air, the barometer, argon and ozone, combustion, matches, yellow and red phosphorus, the nature of flame, candles, oils and petroleum, the elements, chemical formulas, atoms and molecules, distillation, petroleum ether, paraffin and vaseline, the manufacture of illuminating gas and its by-products, the incandescent gas-burner and cooking with gas; artificial fertilizers, bones, superphosphates, potassium salts, acids, bases and salts, foodstuffs, digestion and fermentation, albumen, fats and carbohydrates, alcoholic beverages, vinegar, milk, cheese and butter, gunpowder, gun cotton, dynamite, collodion, wool, cotton and silk; leather and tanning, bleaching and dyeing, ink and paper; the manufacture of soda, potash, sulphuric acid, bleaching powder, soap, caustic soda and potash, glass and porcelain; photography in its various forms including color-photography, the metallurgy of some of the most important metals, alloys, alkaloids, chloral, ether, chloroform, antiseptics, iodoform, carbolic acid, salicylic acid, etc.

The book is illustrated with some fourteen wood-cuts, which add much to the interest in the reading matter and serve to explain much that otherwise might not be so clear to the reader.

The most recent views on the subjects considered are given, and the book is up to date in every particular, and yet the language is so simple and the explanations so clear that any person of average intelligence can readily understand them.

The book is extremely interesting and instructive and will fully repay careful reading. Even the experienced chemist will find here much information not found in the ordinary text-books.

The publication of such a series of popular lectures, which all can understand, must have a very beneficial influence on the study of chemistry and will show the uninitiated, as nothing else can, what the chemist has done and is doing. An English translation of the book by M. M. Pattison-Muir, published by J. B. Lippincott & Co., has recently appeared.

W. R. O.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, JANUARY.

On Parabromdimetanitrotoluol and some of its derivatives: By C. L. JACKSON and M. H. ITTNER. This work was undertaken to study the behavior of a bromine atom, in the ortho position to two nitro groups, but not exposed to a third negative group in the para position. The substances studied were the benzene and toluene bromdinitro compounds. The toluene compound was found to be poorly suited for the research on account of its stability. Several of its derivatives were made and studied; but in some cases the methyl group seemed to exert a protective action, preventing the formation of compounds whose analogues in the benzene series were easily formed. The bromdinitrobenzoic acid was found to be more reactive than the toluic acid. A number of related acids and their salts were made, and attempts were made to greatly increase the complexity of the molecules; but it was found that the substances lost their tendency to crystallize as the complexity increased, and pure substances could not be obtained.

Aluminum Ethylate: By N. H. HILLYER and O. E. CROOKER. In preparing amalgamated aluminum for reduction in neutral solution the authors found that contact with the air was injurious, and they therefore attempted to prepare it in alcohol without allowing it to come in contact with the air. To their surprise, and contrary to the statements of others who had worked on these substances, quite a reaction took place between the amalgamated aluminum and absolute alcohol, the final product being a white solid. This product was distilled, and a mixture of aluminum ethylate and aluminum chloride was obtained.

On the conditions affecting the Volumetric Determination of Starch by means of a solution of Iodine: By F. T. LITTLETON. The author has studied the accuracy of volumetric determinations depending upon the starch iodide reaction. She found that not only was the reaction affected by the temperature, but that starch from different sources gave different results. She reached the same conclusion that has been reached by others, namely, that the so-called iodide of starch is probably not a definite chemical compound and that it is very easily dissociated.

Silver Hydride: By E. J. BARTLETT and W. F. RICE. The authors succeeded in preparing silver hydride by precipitating a dilute solution of silver nitrate with dilute hypophosphorus acid. The product is filtered off rapidly and washed. It forms black spongy flakes and is not decomposed by water.

On the Volatility of Ferric Chloride: By H. P. TALBOT. Conflicting reports are found as to the volatility of ferric chloride, and the author undertook this investigation to determine the accuracy of these statements. He found that ferric chloride is not volatilized by boiling its solutions, and that no loss ensues on heating the dried residue to 130°. In the presence of aqua regia or when overheated with ammonium chloride there is, however, a slight loss.

Concerning properties belonging to the Alcohol-soluble Proteid of Wheat and of certain other Cereal Grains: By G. L. TELLER. The author found that the method of separation of the gluten and non-gluten compounds in wheat, by means of dilute salt solutions, was inaccurate, on account of the fact that the same nitrogen compounds were soluble both in the dilute salt solutions and in 75 per cent. alcohol. He separated the part precipitated by the salt solution, and then added a solution of phosphotungstic acid to the filtrate. By this process he separated the amides from the proteids soluble in salt solution. The part precipitated by the salt solution consisted of edestin and leucosin, and the sum of the nitrogen in these substances and that in the amides subtracted from the total nitrogen gives that in the alcohol-soluble proteid, which is gliadin.

Silicide of Chromium: By G. DE CHALMOT. This investigation shows that not only does chromium form a silicide of the formula $SiCr_2$, the compound obtained by Moissan; but also a compound Si_2Cr, formed by heating chromium sesquioxide, charcoal and silica in an electric arc furnace.

Paraisobutylphenoxyacetic Acid: By W. P. BRADLEY and F. KNIFFEN. This acid was prepared by the same methods used in the formation of its homologue phenoxyacetic acid. A number of its salts were prepared and studied.

On a simple automatic Sprengel Pump: By B. B. Boltwood. The author describes a form of pump which can be easily made and which he recommends as very satisfactory.

The following books are reviewed in this number of the *Journal:* The Practical Methods of Organic Chemistry, L. Gattemann (translated by W. B. Shober); Notes on Qualitative Analysis, W. P. Mason; Chemistry for Beginners, E. Hart; Manual of Determinative Mineralogy, Geo. J. Brush; Chemistry in Daily Life, Dr. Lassar-Cohn; Handbook for the Bio-Chemical Laboratory, J. A. Mandel.

J. Elliott Gilpin.

SOCIETIES AND ACADEMIES.

NEBRASKA ACADEMY OF SCIENCES, DECEMBER 30, 1896.

The seventh annual meeting of the Nebraska Academy of Sciences was held December 29th at Lincoln and the following papers were presented:

Annual address of the retiring President, Prof. E. H. Barbour, on the 'Economic and Educational Value of Academies;' a comparison of the methods of various academies, with recommendations for the betterment of our own.

'A new Plankton Pump,' Prof. H. B. Ward and Prof. Chas. Fordyce, a device for collecting aquatic organisms by pumping from any desired depth; followed by remarks by Prof. Ward on the importance of continued biological observations.

'Report of Progress in the Study of the Fauna of the State,' Prof. L. Bruner, showing how few species have been reported from Nebraska in most groups, although our number of species is undoubtedly very large.

'Some Methods of Collecting, Preserving and Studying Fossils,' Miss Carrie Barbour, illustrating the fact that forms apparently hopelessly disintegrated may be collected and preserved.

'Nomenclature of Nebraska Forest Trees,' Dr. Chas. E. Bessey, giving the history of changes in names of our trees with the names now adopted.

'Reflections on the Genus *Ribes*,' Prof. F. W. Card, urging the validity of species developed by cultivation as well as those found wild whose genealogy is not known.

'Chalcedony-lime Nuts of the Genus *Hickora* from the Bad Lands of Nebraska,' Prof. E. H. Barbour.

'Comparison of Nebraska Diatomaceous Earth from Nebraska and adjacent States,' C. J. Elmore.

'What is Mathematics?' Dr. E. W. Davis, showing how mathematics is designed to coordinate other sciences.

'A Family of Quartic Surfaces,' the sum of the distances of whose locus from two given surfaces is constant, Prof. R. Moritz.

'A Form of Weir Notch,' the flow of water through which varies directly as the head instead of following the more complicated law of the ordinary notch, Prof. O. V. P. Stout.

'An Observation upon annual Rings in Tree Growth,' Prof. F. W. Card, in which complete defoliation did not cause the formation of a second annual ring.

'Internal Temperature of Trees,' R. A. Emerson. Temperatures as high as 110° reached at a depth of one-half inch below the bark of trunks exposed to the sunshine; daily fluctuations greater in dead limbs than in live ones.

Owing to the late hour the following papers were read by title only: 'Notice of two Important Books on Systematic Botany,' Chas. E. Bessey; 'The Barites of Eastern Nebraska and the Bad Lands,' Erwin H. Barbour; 'Some Data as to Wind distribution of Seeds,' Ed. M. Hussong; 'Parasites of Nebraska Dogs,' Henry B. Ward; 'Discovery of the first Meteorite in Nebraska,' Erwin H. Barbour; 'Notes on Phyllopod Crustacea,' H. A. Lafler and A. S. Pearse; 'The Study of Botany in the School for the Blind,' Dr. C. E. Bessey.

The following officers for the ensuing year were elected: President, Dr. A. S. von Mansfelde; Vice-President, Dr. E. H. Barbour; Secretary and Treasurer, Prof. G. D. Swezey; Custodian, Prof. Lawrence Bruner; Directors, Dr. H. B. Ward, Prof. H. B. Duncanson, Mr. C. J. Elmore and Dr. H. Hapeman.

The next annual meeting will be held on the day following Thanksgiving. The volume of proceedings for 1894–95 is just issued. Price, 50 cents.

G. D. Swezey,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON. 269TH MEETING. SATURDAY, JANUARY 3.

MR. F. A. LUCAS exhibited the skull of a Sea Lion, *Eumetopias*, in which one ramus of the jaw had been broken when the animal was quite young. The fracture had not united and, in consequence, only one side of the jaw was functional, the result being that this side had developed more than the other, making the cranium asymmetrical.

Mr. E. W. Nelson spoke on 'New Birds from Mexico,' stating that he had quite recently collected forty-four new species and subspecies, including one new genus, from a comparatively limited area in Mexico and western Guatemala.

Mr. F. A. Lucas read a paper on the 'Natural Mortality among Fur Seals' giving the results of the observations made during the summer of 1896, by the Commissioners of the United States, Great Britain and Canada. It was stated that there was a considerable mortality among very young seals, due to their being trampled on by the adult seals in the harems. This great loss took place only on ground free from obstructions, where the quarrelsome bulls and startled cows could move readily about. Some small number of seals starved from natural causes, a few were drowned, and some died from accidents and diseases, such as inflammation of the bowels, inflammation of the kidneys, etc. The *known* causes of death among the adults were few, principally fighting among the bulls and consequent injury to the females, but it was evident that for some reason the mortality among cows was great.

F. A. LUCAS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis of January 4, 1897, Dr. Amand Ravold gave a microscopic demonstration of Widal's test for typhoid fever, demonstrating that after the disease has existed for four days or more the blood of typhoid patients, probably because of some contained anti-toxine, possesses the power of inhibiting the motion of typhoid bacilli from a pure culture introduced into it within a period of one hour or less, whereas in normal blood similar bacilli retain their power of locomotion for an indefinite length of time. It was stated that typhoid blood possesses this property even after having been dried for a period of four weeks or more, so that a few drops obtained from a person suspected of having the disease may be sent to suitable places for applying the test, thus rendering comparatively easy the early diagnosis of a disease which in its early stages presents many clinical difficulties.

Prof. F. E. Nipher gave preliminary results of partially completed experiments, made through the courtesy of the Burlington and Illinois Central Railroads, to determine the frictional effect of trains of cars on the air near them. His apparatus consists of a cup collector supported on a bar capable of sliding in guides on a clamp attached to the window sill of the car. The bar is thrust out to varying distances up to 30 inches. The mouth of the collector is turned in the direction of motion of the train. The pressure due to the motion is conveyed through a rubber tube attached to the rear of the collector and passing lengthwise through the bar to a water manometer. The manometer has a tube with a rise of 4 or 5 in 100 and is provided with a pivotal mounting and a level.

The pressure near the train is comparatively small and increases as the collector is thrust further out. It approaches a limit corresponding to the train velocity at the instant. Prof. Nipher finds the relation between the limiting pressure and velocity to agree exactly with the formula

$$P = \frac{\delta}{2} v^2$$

where v is the train velocity in centimeters per second, P is the pressure in dynes to the square centimeter, and δ is the density of air in C.G. units at the temperature and pressure of the observations. He finds the pressure a maximum when the axis of the collector is parallel to the direction of motion with the mouth to the wind. Turning the collector until its axis makes an angle of about 60° with this position, the pressure reduces to zero. At greater angles the pressure becomes less than atmospheric pressure by an amount which reaches a maximum at an angle of 90°, and passes through a

minimum at an angle of 180°, when the collector is in a trailing position. The sum of the coefficients for the two positions of maximum compression and minimum exhaust is almost exactly the same as Langley obtained with a pressure board when exposed normally to the wind.

The result shows that a large amount of air is dragged along with the train, the motion being communicated to air many feet away. This air is a source of danger to one standing too near the train when at full speed. One is likely to be toppled over, and the blow of the air communicates a motion of rotation which may cause one to roll under the train if the nature of the ground does not prevent such result. It was remarked, however, that where trains have a right to run at any speed no prudent person would stand so near to a train as is necessary in order to be in danger from this source.

The following officers were declared elected for the year 1897: President, M. L. Gray; First Vice-President, E. A. Engler; Second Vice-President, Charles R. Sanger; Recording Secretary, William Trelease; Corresponding Secretary, E. C. Runge; Treasurer, Enno Sander; Librarian, G. Hambach; Curators, Julius Hurter, J. H. Kinealy, E. Evers; Directors, M. H. Post, Joseph Grindon.

One person was elected to active membership.

William Trelease,
Recording Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB.

At the December meeting, Dr. Marcy in the chair, Prof. Crook presented 'Some Geological Causes of the Scenery of the Yellowstone National Park' as a report upon a trip to that region. The nature of the scenery is due: 1, to the fact that the country is geologically young, having begun to take its present form at the close of the Cretaceous; 2, to the fact that it is composed of volcanic materials which were erupted in this order, viz: Andesite, rhyolite, basalt; 3, to the fact that the rhyolite is not yet cooled; and 4, to the fact that the topography of the country causes precipitation of meteoric waters unusually great for that region and, consequently, low temperature and powerful erosion. The difference in chemical composition of the spring waters is accounted for on petrographical grounds.

Geyser action is satisfactorily explained in accordance with Bunsen's theory. The unique coloring in the region is due to biological and to mineralogical causes. Twenty hand specimens and thin sections and fifty lantern slide views illustrated points considered.

Evanston, Ill. A. R. Crook,
Secretary.

UNIVERSITY OF WISCONSIN SCIENCE CLUB, DECEMBER 16, 1896.

Prof. C. R. Van Hise, in his paper, 'The Deformation of Rocks,' discussed the subject in general. It was shown that, in order to adequately understand the phenomena of deformation, the position of rocks with reference to the surface must be considered. Observations in the field show that there are three somewhat distinct zones—an outer zone of fracture, a middle zone of combined fracture and folding, and a deeper seated zone of folding. However, whether folding or fracturing occurs depends largely upon the rapidity of deformation and upon the strength of the rock in question, as well as the superincumbent load. Therefore at the same depth may be found all the phenomena of the zones of fracture and flowage; but, broadly stated, the outer zone is particularly characterized by joints, faults and brecciation; the deep seated zone is particularly characterized by folding and cleavage; and the middle zone shows all of these phenomena with various complex relations.

Mr. L. S. Cheyney, in his paper, 'Résumé of Work done on the Flora of Wisconsin,' discussed briefly the history of systematic botanical investigation upon the vegetation of the territory now included in the limits of the State, from the journeys of the Jesuit missionaries to the present time.

Mr. C. H. Ford, in his paper, 'The Modern Telephone Transmitter,' gave an account of some original work done to test the comparative worth of modern transmitters.

Wm. S. Marshall,
Secretary.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, JANUARY 29, 1897.

CONTENTS:

Cycle in the Life of the Individual (Ontogeny) and in the Evolution of its own Group (Phylogeny): ALPHEUS HYATT 161
The Blackboard Treatment of Physical Vectors: C. BARUS 171
Zoological Notes:—
Nansen's Discovery of the Breeding Grounds of the Rosy Gull: T. S. PALMER. *Origin of Parasitism in the Cowbird:* O. WIDMANN 175
Current Notes on Physiography:—
Branch Streams of the Schuylkill; Hann's Allgemeine Erdkunde; The Topographical Association; Notes: W. M. DAVIS 177
Current Notes on Anthropology:—
The Game of Mancala; Oriental Items of Ethnologic Interest: D. G. BRINTON 178
Notes on Inorganic Chemistry: J. L. H. 179
Astronomical Notes: H. J. 180
Scientific Notes and News 181
University and Educational News 185
Discussion and Correspondence:—
Simplified Spelling: G. K. GILBERT. *An Explanation of the so-called Pseudo-aurora:* J. PAUL GOODE 185
Scientific Literature:—
Catalogues des bibliographies geologiques: G. K. GILBERT. *Johonnot's Principles and Practice of Teaching; Jackman's Nature Study:* CHARLES WRIGHT DODGE. *Papers presented to the World's Congress on Ornithology:* C. F. BATCHELDER ... 187
Scientific Journals:—
Journal of Geology: H. F. B. *Terrestrial Magnetism* 190
Societies and Academies:—
The Scientific Association of Johns Hopkins University: CHAS. LANE POOR. *The Anthropological Society of Washington:* J. H. MCCORMICK. *Washington Section of the American Chemical Society:* V. K. CHESNUT. *Boston Society of Natural History:* SAMUEL HENSHAW. *Geological Club of the University of Minnesota:* CHAS. P. BERKEY. 192

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*CYCLE IN THE LIFE OF THE INDIVIDUAL (ONTOGENY) AND IN THE EVOLUTION OF ITS OWN GROUP (PHYLOGENY).**

THE organic cycle, as generally understood both by laymen and scientists, and as usually described in literature, is, as a rule, considered from a physiological rather than structural point of view. The development of the young, and the attainment of the adult or comparatively permanent, stage completes the progressive stages. Old age, accompanied by losses of characteristics and functions and consequent weakening of the body, is retrogressive and brings on second childhood, thus completing the cycle in the ontogeny.

My purpose to-night is to show that the cycle is also represented in the life history of the individual by definite structural changes, and that these have direct correlations with the history of the changes in the forms of the group while evolving in time.†

The fundamental discoveries that are

* This paper was in large part read as a general summary of the phenomena of cycles, before the American Academy in Boston, but does not assume to be an exhaustive or even complete account of the literature or theoretical views treated of.

† These correlations have been more fully stated in a number of publications by the author, especially 'Genesis of the Arietidæ,' Smithsonian Contribution, 673, and Mem. of Mus. of Comp. Zoology, Vol. XVI.; 'Bioplastology and the Related Branches of Scientific Research,' Proc. Bost. Soc. Nat. Hist., XXVI.; and 'Phylogeny of an Acquired Characteristic,' Proc. Am. Phil. Soc., XXXII., No. 143.

more than any other directly useful in the study of the phenomena of the cycle, both in ontogeny and phylogeny, may be briefly noticed as follows:

The opinion that the higher animals are complex, colonial aggregates of cells, which in structure are equivalents to the lowest and minutest adult forms of the animal kingdom, the unicellular bodies of Protozoa, has been steadily gaining in probability since it was first announced by Oken in 1805, in 'Die Zeugung,' Frankfurt bei Wesche, 8vo. This work we have not yet seen, but in the first edition of the Naturphilosophie, Jena, 1809, II., XII. Buch, Zoogenie, he describes protoplasm as 'Punktsubstanz' and as giving rise to the 'Blasenform or Zellform' in both animals and plants. Oken considered the lower animals 'Polypen, Medusen, Beroen, kurz alle Gallertthiere' to be composed of Punktsubstanz.' The nerves, the cartilage, bones of higher animals, were considered as modifications of this form of 'protoplasm,' but the skin and fleshy parts, including the viscera, were described as cellular, 'dem Fleisch liegt die Bläschenform zu Grunde;' again on p. 30, 'die Eingeweide welche am meisten aus Zellengewebe bestehen.' Oken in XII., VIII. Buch, treats of the subject we are more immediately interested in and writes as follows: "Pflanzen and Thiere können nur Metamorphosen von Infusorien sein," "im kleinsten sind sie nur infusoriale Bläschen die durch verschiedene Combinationen sich verschieden gestalten and zu höheren Organismen aufwachsen," and also adds on p. 29, in anticipation of one of the points advanced by the author in his 'Larval Theory of the Origin of Cellular Tissues,'* 'auch besteht der Samen aller Thiere aus Infusorien.'

This author directly compares his cystic or intestinal animals, Infusoria, with ova, and speaks of them as oozoa, and in the preface to the English edition of his Physiophilosophy, Lond. 1847, Roy. Society, he writes that all organic beings originate from and consist of vesicles or cells. "Their production is nothing else than a regular agglomeration of Infusoria; *not, of course, of species previously elaborated or perfect, but of mucous vesicles or points in general which first form themselves by their union or combination* into particular species." Oken's view was based on the resemblances existing between the Protozoa and the cells in the tissues of the Metazoa, and it is evident he is entitled to be considered the first teacher of the unicellular doctrine, an honor now universally given to von Siebold.

However imperfect and imaginative the results as compared with the more objective statements of later observers, the author who wrote such sentences as these had as clear ideas as the knowledge of his time permitted and was the Haeckel of the early part of this century, and like him a great and successful leader, making many errors but also many discoveries and 'blazing out' some of the paths that we are still following.

Meckel* seems to have been the first author who brought together and stated in a clear way the scattered observations and ideas with regard to the correlations existing between the transient stages of development of the individual and the so-called permanent modifications represented by the similar characters in the adult stages of similar forms.

Meckel says: "Es giebt keinen guten Physiologen, den nicht die Bemerkung frappirt hätte, dass die ursprüngliche Form aller Organismen eine und dieselbe ist, und dass

* Proc. of the B. S. N. H., Vol. XXIII., March 5, 1884.

* Meckel. 'Entw. e. Darstellung der Embryonalzustände d. höheren Thiere u. d. Perman. d. zu d. niedern stattfindenden Parallele.' Beitr. z. vergeich. Anat., II., Leipzig, 1811, pp. 1–148; Meckel speaks of his publications as only preparatory to more extended researches.

aus dieser einen Form sich alle, die niedrigsten wie die höchsten so entwickeln, dass diese die permanenten Formen der ersten nur als vorübergehende Perioden durchlaufen. Aristoteles, Haller, Harvey, Kielmeyer, Autenrieth und mehrere andere haben diese Bemerkung entweder im Vorübergehen gemacht oder, besonders die letzen, hervorgehoben und für die Physiologie ewig denkwürdige Resultate daraus abgeleitet.

"Von diesen niedrigsten Wirbelthieren an bis zu den höchsten Geschlechtern lässt sich die Vergleichung zwischen dem Embryo der höhern Thiere und den niedern im vollkommenen Zustande vollständiger und treffender durchführen.

"In der That giebt es ja eine Periode wo der Embryo des höchsten Thieres, wie schon Aristoteles sagt, nur die Gestalt einer Made hat, wo er ohne äusere und innere Organisation, bloss ein kaum geformtes Klümpschen von Polypensubstanz ist. Ungeachtet des Hervortretens von Organen bleibt es doch noch wegen des gänzlichen Mangels eines innern Knochengerüstes eine Zeitlang Wurm und Mollusk und tritt erst später in die Reihe der Wirbelthiere, wenngleich Spuren der Wirbelsäule schon in den frühesten Perioden seinen Anspruch auf diese Stelle in der Reihe der Thiere beglaubigten."

It is very obvious, from these statements of Meckel's, that the correlations of embryology and the epembryonic stages of the individual with the permanent modifications of animals of simpler construction was understood, as far as was possible with existing knowledge, from the time of Aristotle and that it was, to a greater or less extent, a working hypothesis at that time and, as declared by him, had been helpful in giving a clearer understanding of the development of the individual and of the relations of the individual to the whole animal kingdom.

The next step was taken by von Baer, in dividing the animal kingdom into four types and in limiting this general statement to animals occurring within each of these types. He also considered it highly probable (not barely possible, as it is quoted by some writers) that the earliest stages of the embryo resemble in aspect the adult stages of the lowest grade of forms in the animal kingdom. He had in mind in this statement the modern view of the affinities of the earliest stages of the embryo or its repetitions of the characteristics of Protozoa,* so far as the knowledge of his time permitted.

Von Baer endeavored to prove that each of the four types had similar embryos and that the type characters were determinable at early stages in the ontogeny. Both von Baer and Louis Agassiz were pupils of Ignatius Dollinger, an embryologist who published nothing. Both of these eminent men have recognized him as their master in embryology, but have given no definite statement of what they were taught by him. Louis Agassiz accepted von Baer's opinions and subsequently enlarged them, when he published on his fossil fishes by the introduction of the element of succession in time and thus laid the basis for all more recent work.

Agassiz gave the fullest expression of his views in 'Twelve Lectures on Comparative Embryology,' Lowell Institute, Boston, 1848–49, subsequently published in pamphlet form. One wonders as he reads how any man holding such views could have held his mind closed to the conclusion that animals were evolved from simpler or more primitive forms. The effect of theoretical preconceptions in closing the mind to the reception of new ideas never had a stronger illustration. Louis Agassiz, in 1849, had all the facts essential for building up a hypothesis of evolution that would have

* Entwickelungsgesch. d. Thiere, Scholion V., p. 199, p. 120, etc.

placed him in the history of science on the same line with Lamarck and Darwin.

He states four lectures, p. 26, as follows: "The results thus far obtained in the lectures which I have delivered can be expressed as follows: There is a gradation of type in the class of Echinoderms, and indeed in every class of the animal kingdom, which, in its general outlines, can be satisfactorily ascertained by anatomical investigation; but it is possible to arrive at a more precise illustration of this gradation by embryological data. The gradation of structure in the animal kingdom does not only agree with the general outlines of the embryonic changes. The most special comparison of these metamorphoses with full grown animals of the same type leads to the fullest agreement between both, and hence to the establishment of a more definite progressive series than can be obtained by the investigation of the internal structure. These phases of the individual development are the new foundations upon which I intend to rebuild the system of zoology. These metamorphoses correspond, indeed, in a double sense, to the natural series established in the animal kingdom: first, by the correspondence of the external forms, and secondly, by the successive changes of structure, so that we are here guided by the double evidence upon which the progress in zoology has, up to this time, generally been based.

"Their natural series again correspond with the order of succession of animals in former geological ages, so that it is equally as true to say that the oldest animals of any class correspond to their lower types in the present day as to institute a comparison with the embryonic changes, and to say that the most ancient animals correspond with the earlier stages of growth of the types which live in the present period. In whatever point of view we consider the animal kingdom, we find its natural series agree with each other; its embryonic phases of growth correspond to its order of succession in time, and its structural gradation, both to the embryonic development and the geological succession, corresponds to its structure; and if the investigations had been sufficiently matured upon this point, I might add that all these series agree also in a general way with the geographical distribution of animals upon the surface of our globe, but this is a point upon which I am not yet prepared to give full and satisfactory evidence. So much for the views referring to embryology in its bearing upon zoological classification."

And again on p. 27:

"However, another step had to be made to show a real agreement between the earlier types of animals and the gradual development of the animal kingdom, which has been the last progress in our science of fossils: namely, to show that these earlier types are embryonic in their character—that is to say, that they are not only lower in their structure when compared with the animals now living upon the surface of our globe, but that they actually correspond to the changes which embryos of the same classes undergo during their growth. This was first discovered among fishes, which I have shown to present, in their earlier types, characters which agree in many respects with the changes which young fishes undergo within the egg. Without entering into all the details of these researches, I will conclude by saying it can now be generally maintained that earlier animals correspond not only to lower types of their respective classes, but that their chief peculiarities have reference to the modifications which are successively introduced during the embryonic life of their corresponding representatives in the present creation. To carry out these results in detail must now be, for years to come, the task of paleontological investigations."

Perhaps, in consequence of pressure of other work or of his theoretical views, Louis Agassiz seemed to have lost sight of the great importance of continuing his researches upon the meaning and correlations of the epembryonic stages. These were referred to in his publications, but were not made as prominent as they deserved after the lectures at the Lowell Institute in 1849, and in his personal talks with his students or in his lectures I cannot remember that they were ever treated directly by anything more than incidental references, although embryology was very often the principal theme.

Nevertheless, I must have got directly from him, subsequently to 1858, the principles of this branch of research, and through this and the abundant materials furnished by the collections he had purchased and placed so freely at my disposal, I soon began to find that the correlations of the epembryonic stages and their use in studying the natural affinities of animals was practically an infinite field for work and discovery.

Although within a year after the beginning of my life as a student under Louis Agassiz I had become an evolutionist, this theoretical change of position altered in no essential way the conceptions I had at first received from him, nor the use we both made of them in classifying and arranging forms. This experience demonstrated to my mind the absurdity of disputing the claims of any author to the discovery of a series of facts and their correlations because of his misinterpretation of their more remote relations or general meaning. It is of some importance to notice this because it is the rule now to attribute von Baer's and his predecessors' and Louis Agassiz's discoveries in this line to Haeckel. This eminent author has, indeed, given one of the most modern definitions of this law and has named it the 'law of biogenesis.' Haeckel's discoveries in embryology are sufficiently great without swelling the list with false entries, but it will probably be a long time before naturalists realize and acknowledge this error. Some of the most eminent embryologists in this country have adopted the Haeckelian nomenclature without sufficient critical examination of the term under discussion. The so-called Haeckelian ('law of biogenesis') is really Agassiz's law of embryological recapitulation restated in the terms of evolution.

It has surprised me that serious objections to the use of the word 'biogenesis' in this connection have not been made. This word has been long employed in another sense as antithetical to 'abiogenesis.' The latter has been for many years applied to the theory of the generation of living from inorganic matter, and the former to the theory asserting that living matter can originate only from living matter; the use of the phrase 'the law of biogenesis' is consequently inappropriate, since neither did Agassiz's nor Haeckel's discoveries cover so much ground. The former gave us a law for the correlations of the earlier stages of ontogeny with phylogeny. This cannot be called 'the law of biogenesis,' since that has been long ago stated as the law of the origin and continuity of organism, or in other words, the genesis and continuity of life from and through living matter only. There are two different manifestations of Agassiz's law, which Haeckel defined and named 'palingenesis' and 'conogenesis,' the former referring to the ordinary as regular mode in which the characteristics of ancestors are repeated in the development of the individual and the other to what is frequently called the abbreviated mode, etc.

These two modes are by no means all, but at present only the first or simplest manifestations of the phenomena need be treated of. This, or what Haeckel very

appropriately calls 'palingenesis,' was what Louis Agassiz had studied and, so far as all the essential facts were concerned, thoroughly understood, and it was this that he taught his students, so that it became, at any rate in my own case, the foundation of all my subsequent work in determining the mutual relations of forms. If then, as I have proposed in former publications, the term 'law of palingenesis' be adopted this expressly states just what Louis Agassiz discovered.

Observations upon this ground made especially upon Cephalopoda have led to the discovery of correlations between the latter or epembryonic stages and the adult stages of extinct ancestors which have greatly enlarged the field of application of Agassiz's law of palingenesis and given it an exactitude that has made it of surpassing importance in the study of evolution. Beecher has been able to point out the single species of Brachiopod from which the whole of the vast number of distinct forms of this great group have originated. He has established this fact not only by showing that the young of the existing and fossil forms all repeat more or less at one stage the form of the adult of the initial species, but has also found a very near affinity of this single ancestral species as a fossil appearing in one of the earliest of the fossil-bearing formations.

Dr. R. T. Jackson has done the same work for the Pelecypoda, tracing all to one genus, *Nucula*, and has treated the Echinodermata in the same way, tracing them by the use of Agassiz's law to the genus *Bothriocidaris*.

Although the evidence is perhaps less conclusive with reference to the ancestor of Cephalopoda as a whole, this class has furnished the means of showing the action of this law in smaller groups with great accuracy. It has been possible to trace the origin of a number of smaller groups to single ancestors within the class by carefully studying the correlations of the epembryonic stages with the adults of the same group that have preceded them in time, and this study has also led to further discoveries. It has been found that the new characters were first introduced in the later stages of ontogeny, usually in the full-grown stage; then, as old age approached, certain losses of the characters of the adult took the place, or, if additional growths were acquired, these were of a peculiar kind. These senile stages had been noticed by D'Orbigny and Quenstedt, but these authors did not attempt to show that any correlations existed between any stages of the ontogeny and the gradations occurring in the full-grown forms during their evolution in time, or what is called phylogeny. The oldest stage of the shell in Cephalopoda, Brachiopoda and Pelecypoda is commonly marked by a series of retrogressive changes, which have been fully described elsewhere. These changes have a similar nature to those found in the old age of man, but they are more noticeable because they are recorded in the permanent characters of the hardened shell. The old man returns to second childhood in mind and body, and the shell of the cephalopod has in old age, however distinct and highly ornamented the adult, very close resemblance to its own young. This resemblance is a matter of form and aspect only, since there can be no close comparison in minute structure, nor functions between organs and parts at these two different ends of life. Such analogies, however, have their own meaning and are of great importance when properly translated.

In the first place they show that the cycle of life as manifested in man is found also in the ontogeny of other animals and more pefectly in proportion to the perfection of the record. They are consequently among shell-bearing animals, especially those that carry their embryonic shells and

all their subsequent stages of development throughout their lives, more perfect, more decisive, as well as more obvious, than in animals, like the vertebrata, which carry no such burden of hard, dead parts upon, and in which their stages of development are recorded. The cycle of the ontogeny is, therefore, not only physiological, but it is also a definite series of structural changes and is often accompanied by transformations of remarkable and sometimes startling character.

These retrogressive transformations in old age of the shells of Cephalopoda, Brachiopoda and Pelecypoda have been found to have decided correlations with the adult characters of species that appear simultaneously or later in time. If one traces any group through its evolution in time it has, as stated by many authors, a period of rise called the epacme, a second period of greatest expansion in numbers of forms and species called the acme, and then usually a movement towards contraction called the paracme. All three of these terms were first proposed by Haeckel, who used them largely in a physiological or dynamical sense. The epacme of any group, large or small, is usually a process of evolution by addition of new structures or characteristics based on older structures and thus leading to greater and greater complication of the primitive organization. The acme represents the time of greatest complication in structure and greatest expansion in numbers of forms for any group, large or small. The paracme is the decline, and this takes place through the reduction and actual loss of structures and characteristics that have been built up by evolution during the epacme. This is no ideal picture, but a simple statement of the experiences of those paleontologists who have patiently traced the history of groups through geologic time. Agassiz's law enables one to follow the epacme of the evolution of a species, or genus, or order, or larger group, but further correlations between the cycle of individual life and those in the evolution of its own genetic group must be sought in the correlations existing between the older retrogressive stages of the ontogeny and the paracme of each group.

The importance and peculiar nature of these corelations led me, in one of my papers, to introduce, for this branch of research, the term Bioplastology, which will be found convenient by those interested in this class of work.

The following table of terms is useful here to explain the relations of the cycle of development in the individual to that of the group to which it belongs.

TERMS OF BIOPLASTOLOGY EXPLAINING THE CORRELATIONS BETWEEN STAGES OF THE ONTOGENY AND THOSE OF PHYLOGENY.

Ontogeny or Development			Phylogeny or Evolution of the Phylum		
Structural Conditions	Stages		Structural Conditions	Stages	Dynamical
Anaplasis	Embryonic	Embryo or Foetal	Phylanaplasis	Phylembryonic	Epacme
	Nepionic	Baby		Phylonepionic	
	Neanic	Adolescent		Phyloneanic	
Metaplasis	Ephebic	Adult	Phylometaplasis	Phylephebic	Acme
Paraplasis	Gerontic	Senile	Phyloparaplasis	Phylogerontic	Paracme

The dynamical terms are quoted from Haeckel and were used by him to designate the phenomena of the rise and decline of types, and also the terms anaplasis and metaplesis. He, however, used 'cataplasis' in place of paraplasis, which is here preferred on account of the faulty derivation of cataplasis.

He realized the importance of these phe-

nomena and also the significance of the structural characteristics of decline, but did not trace out the distinct correlations which are claimed as fundamentals in bioplastology.

The terms anaplasis, etc., and their correspondence, phylanaplasis, are the structural correlatives of dynamical terms, epacme, etc., and will be found useful when the statical phenomena or structures are mentioned or contrasted with the dynamical phenomena, or with periods of time in which they occur, since the terms epacme, acme and paracme also refer to time. Terms of the ontogeny are placed opposite to their correlatives in the column of phylogenetic terms, but in reading the table it should be clearly understood that the individual whose life history is represented by the first three columns is supposed to have been taken from the midst of those that lived during the acme of the phylum and belonged to a phylephebic species. In studying the development of such an individual it has been repeatedly observed that the embryo repeated the adult characters of the most ancient representatives of the phylum, which are here called in accordance with this evidence, phylembryonic.

It has also been ascertained that there are full-grown types in the epacme and acme of groups which correspond to the transient nepionic or baby stage of those that occur later in time; these are the phylonepionic; others have similar correspondences with the neanic stages and are properly designated as phyloneanic types or forms. The structures of the ephebic (adult) stage are essentially the differentials of the time and fauna in which they occur, and necessarily have no correlations with the past. Their relations are obviously and wholly with the present, except in so far as they represent the consummations of evolution in structures. The structural changes in the gerontic stage of the individual are repeated with sufficient accuracy in the adult, and often even in the neanic stages of types that occur in the paracme of the evolution of a phylum, so that one is forced to consider seriously whether they may not have been inherited from types that occur at the acme of the same group. The fact that these changes occur first in the ontogeny during the gerontic stage does not necessarily imply that they first make their appearance after the reproductive period. No gerontic limit is known to the reproductive time in the lower animals, and it may well be that the continual recurrence of gerontic stages in individuals during the epacme of groups may lead to their finally becoming fixed tendencies of the stock or hereditary in the phylum, and thus established as one of the factors that occasion the retrogression or paracme of groups. The paracme may also be considered as occasioned by changes in the surroundings from favorable, as they must have been up to acmatic time to unfavorable during the succeeding paracmatic period in evolution. Still a third supposition is also possible, viz., that the type, like the individual, has only a limited store of vitality, and both must progress and retrogress, complete a cycle and finally die out, in obedience to the same law.

All of these views can be well supported, but, whatever may be the true explanation, it is obvious that there are plenty of paracmatic types, which, in their full-grown and even in their neanic stages, correlate in characters and structures with the characters and structures that one first finds in the transient gerontic stages of acmatic forms of the same type. These can, therefore, be truthfully and accurately described as phylogerontic in the phylum.

In other words, one is able to apply gerontic changes in the ontogeny to the deciphering of the true relations, the ar-

rangement and classification forms occurring in the paracme, just as Agassiz's law of palingenesis can be used to explain the relations of the links in the chain of being forming the epacme of groups.

The cycle of the ontogeny is, therefore, the individual expression and abbreviated recapitulation of the cycle that occurs in the phylogeny of the same stock, and, while the embryonic, nepionic and neanic stages give us, in abbreviated shape, the record of the epacme, the gerontic stages give, in a similar manner, the history of the paracme.

The difference between the nature of the two records is, however, necessarily as great as between the beginnings and the endings of existence. The successive stages of the individual are derived from the past, and simply point backwards along the track traversed by the phylum; the successive changes of the gerontic stage on the other point to the future, and are prophetic of what is to come in the decline of the type. The retrogressive decline of the individual and of its type are along parallel lines and the two are in direct correlation, so that the former becomes an abbreviated index of the latter.

One of the most useful results of these studies has been the method of work developed, the mode of study by series. To follow it out successfully one must trace the terms of series from the first, or most primitive, grade to the last, through perhaps long periods of time and, if upon the same level, through many gradations of structure.

The histologist and embryologist picks out a convenient form here and there for thorough investigation, but does not seem as yet to see the importance of the point of view here insisted upon, viz., that the only method of getting at the correlations of ontogeny and phylogeny is by following out the history of representative series of genetically connected embryos, and the same is true of the experimentalist. While, consequently, their results have been in the highest degree instructive and progressive along other lines of research, they throw no very strong light on the laws of evolution, and the best modern works on embryology, zoology and experimentation neglect the only proper and efficient mode of studying one very important side of their subject.

One of the results of this mode of study has been the discovery of the law of acceleration in the inheritance of characters, or tachygenesis. Thus it has been found that characteristics are inherited in successive species or forms in a given stock at earlier and earlier stages in the ontogeny of each member of the series. These characteristics, as a rule, disappear from the ontogeny altogether in the terminal, or last-occurring, members of a series, and terminal forms thus become very distinct in their development. This law I habitually illustrate as the crawling, walking, hopping, skipping and jumping law.

Another result of this mode of study is the discovery that, in most genetic series, primitive forms exhibit much greater indifference to geologic changes, persist with comparatively unchanged structures through longer periods of time than those that occur at the acme of groups, and paracmatic forms, if widely distributed, are apt to be particularly short lived, and are very often narrowly localized in origin and duration. Primitive forms are also less changeable in their ontogeny; the adult differs less from either the young or the old than in acmatic forms. The same is true of phylogerontic forms; their old age and youth are less distinct as stages from each other than in acmatic forms. Primitive forms are less affected by gerontic changes in their ontogeny, *i. e.*, they have shorter old-age stages than acmatic forms. Paracmatic forms have much longer old-age or gerontic stages than acmatic forms.

Lastly, it has been found that at the beginning of the evolution of any stock the progress was not only very rapid, but the departures in structures much more marked between the diverging lines of different species, genera or families, and so on, than those that subsequently occurred in any one of these. This rapidity of expansion is also marvellously sudden in every series near its point of origin, and it is equally so in the whole animal kingdom, which appears with the larger proportion of all its principal divisions in the earliest known fossil-bearing rocks. Each series or type appears to have had a more or less free field, and its first steps in evolution were obviously not affected by natural selection. Subsequently, in the acme of the same series or type, the departures became less marked, and the divergences took place in less important structures; in other words, as stated above, the evolution is slower.

On the other hand, after the acme is passed and the paracme sets in, there is a sensible quickening of evolution during decline.

Phylogerontic forms become more and more numerous, and there are wider departures in the structures from the acmatic forms than any of the divergences that occur within the acmatic forms themselves.

The hopping, skipping and, at last, the jumping begins in the extremes of the series, so that it becomes difficult, as has been shown by the author in a number of series and by Cope when giving illustrations of the action of the law of tachygenesis, to connect one of these extreme forms with its nearest congeners.

The characters of the cycle in the ontogeny are here again similar to those of the phylogeny; thus the final substages of the gerontic stage are wider departures from the ephebic substages than these are among themselves and when compared with each other. The analogy of the old with the young shows this most conclusively and with the similarity of phylogerontic forms in the same stock occurs a parallelism in the phylogeny.

In fact, there is no end to the homological and analogical similarities and parallelisms of ontogeny and phylogeny wherever both are found complete.

There are types in which the ontogeny is incomplete, as among insects and other purely seasonal animals, and in these it becomes difficult, if not impracticable, to study the gerontic stages, and thus translate the phylogerontic types if they occur. These same types, and others also, present difficulties in their larval stages, owing to their indirect modes of development, which have been discussed by the author in Insecta and other publications, and need only be referred to here.

One of the bearings of these researches is of interest on account of the discussions between biologists, geologists and mathematicians with regard to the length of time that life has existed on this planet and the bearing of this upon calculations with regard to the age of the earth. It cannot be assumed that the time ratio was the same during the eozoic or pre-Paleozoic as during the Paleozoic or the Mesozoic, so far as the evolution of forms is concerned. The evidence is very strong that great structural differences were evolved much more quickly in these early times, and the probabilities are that the progressive steps of the evolution of the primitive types of organisms took place with a rapidity unexampled in later ages. If the laws of bioplastology are true the evolution of these forms must have occurred more quickly than those of their descendants, except perhaps some isolated phylogerontic types and phylopathic forms.*

* The phrase 'evolution by saltation' has been used for the sudden appearance of divergent types by several authors, first by Dr. W. H. Dall; but this seems

The author in other publications has claimed that this must have been the law, and explained the phenomena as parallel with that which takes place at the beginning of every series arising in the Paleozoic and Mesozoic, and also according to Minot's law of growth and other phenomena of the earlier stages in the ontogeny of every animal

All inferences with reference to the length of time that life has existed upon the earth are consequently defective, since, as far as known to the author, they do not take into consideration the differing rates of evolution at different times in the history of organisms.

ALPHEUS HYATT.

THE BLACKBOARD TREATMENT OF PHYSICAL VECTORS.

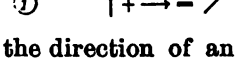
THE tedious part of geometrical reading is the need of searching for the letters which designate the lines. Frequently this is the chief difficulty in the demonstration. In a measure, the same is also true when a geometrical proof is to be written down, particularly where special vector symbols (*e. g.*, the $[AB]$ of Mœbius) are employed. There is, perhaps, no remedy for this in printed work; but in the classroom, with a blackboard available, coplanar vectors may be drawn in great variety at pleasure. I will therefore describe the following method of elementary treatment which, though it contains no essential novelty, is new, I think, from a pedagogic point of view, and for this reason not without value.

Of the four specifications which characterize a vector—position, quantity, direction, sign—the first three usually come within the range of indulgence of the average student; but with the sign he will have nothing to do. Thus it becomes necessary to especially emphasize the latter, and this is done by putting an arrowhead on the proper end of it. A physical vector is thus fully given by an arrow of definite length, originating in a definite point and pointing in a definite direction. With this laid down insistently, the principle of vector summation is next developed* in the usual way. Here, again, the sign quality needs to be accentuated. The origin of the first arrow is the given point of application. The origin of every other arrow is the point of the preceding, beginning with the first arrow already placed. If two vector systems are equivalent, this implies that if the free tail of each begins at a common point, then the free tip of each system must terminate in the same final point.

It is simpler to begin with the first kinematic vector, velocity, rather than with displacement. The inherent importance of the space relations is easily pointed out in the course of the development.

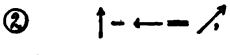
With these customary introductions it is my plan to write down vector equations on the blackboard just like algebraic equations, using for my terms definitely specified arrows. Thus I obtain consecutively:

Sum: The equation reads, for instance,

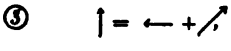


To change the direction of an arrow is to change the sign of the term. Hence (1) is identical with (2).

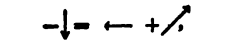
Difference:



or by transposing,



which may be tested by construction. Again from (3)



to the author to be simply a mode of expressing a general fact, or series of facts, that occur everywhere, and in all series more or less through the action of the law of tachygenesis.

* By supposing one of the vectors to be forming on a blackboard moving as specified by the other vector.

and by transposing

④

which is the *triangle of rest.*

Change of velocity: If in the following equation (5) the second term of the first member is given as having changed into the first, then the change of velocity is

⑤

Polygon of velocity: If any number of velocities are given to be added,

which is the polygon of velocities, and all possible constructions are equivalent to a mere change in the order of the terms. If we change the sign and direction of the arrow in the second member of (6) and then transpose the term to the first member

⑦

which is the polygon of rest.

Acceleration: That accelerations may be compounded like velocities students assert readily enough, but few really understand the assertion. Defining acceleration in the usual way, the product of a time factor and a vector is here encountered. But the time factor is scalar and can be fully given by an ordinary number. Let t be a sufficiently small interval of time. Then, for the case of linear acceleration, the equation reads

where the quantity in parenthesis is the observed change of velocity in the time t. The result merely calls for an increase in the length of the reduced vector, $1/t$ times. The more general case corresponding to (5) may be taken at once, whence,

⑧

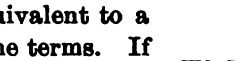
Two accelerations of the general kind may be compounded (using a common time t for brevity), as follows:

⑨

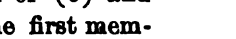
The quantities really compounded are thus the velocities (ultimately displacements) and the effect of the scalar factor is a mere change of the length of the arrow produced.

The case of a finite acceleration and vanishing t is particularly remarkable.

Momentum: If m denote mass, we again have the product of a scalar and a vector, in which, therefore, m is fully given by a number. To compound

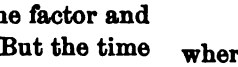
⑩ 

we virtually reproduce (1). If the momenta are referred to different masses, as in

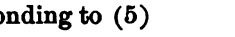
⑪ 

it will be necessary to change the length of each arrow before compounding. The proposition may be extended to the polygon of moments, etc., as already shown.

Force: If the interval t is sufficiently small, force is defined, in a general way, by

⑫ 

where in the first member the second term (vector) is changed to the first term in the time t for each particle of the mass m. The quantity compounded is again the product of a vector (velocity) and a scaler m / t. To compound forces we thus virtually compound velocities and increase the length of the arrow resulting m / t times. If two forces actuate m we have in the most general case

⑬ 

These forces might have been rated in terms of different masses, m and m', and times, t and t'. In such cases the first resultant would be multiplied m / t times and the

second m' / t' times and the new vectors then compounded.

Center of Mass: To complete the subject of translational motion for an extended body the customary reference is made to the center of mass.

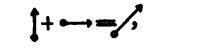
ROTATION.

The case of rotation is treated throughout in complete analogy with the foregoing. What was linear velocity constant throughout the body in the above is now angular velocity also constant throughout the body; what was mass m has become moment of inertia n, and what was force F has become torque T—formally speaking, of course. The results are reached in the usual elementary way.

The first proposition to be laid down is Lagrange's well-known elementary proof for the composition and resolution of angular velocities. This must be most carefully done; for if students growl at the sign of a translational velocity they break out in open mutiny at the sign of an angular velocity. Obviously the arrow is again necessary for the complete specification, and I am in the habit of using the sign of Mars (σ) for angular velocities, measuring the arrow from the center of the circle. As a rule, only one of a group of velocities need be so marked. If right-handed relations be postulated (the reverse is the rule in dynamics) then an eye looking in the direction of the arrow sees clockwise rotation around it as an axis, with a speed given by the length of the arrow.

Thus one obtains in succession :

Angular velocity:



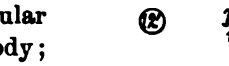
reproducing all the propositions (1) to (6) above. Stress must be laid on proposition (5).

Angular acceleration: Essentially like (8) and (9) above.

Angular momentum, moment of momentum: If n and n' be the moments of inertia the quantities to be compounded are, for instance,

reproducing (10) and (11′) above.

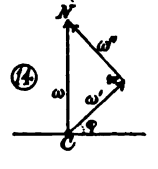
Torque, couple, moment of rotation: If t be sufficiently small, torque is defined in in the most general way by



where in the first member of the equation the second vectorial term (angular velocity) changes into the first term in the time t for every particle of the mass implied in n. Thus the propositions (12) and (13) are formally reproduced for rotations. In other words, torques, couples, moments are compounded just like forces, and the convention involved is the convention made in representing angular velocities.

I will conclude by giving a few examples, the first of which, *Foucault's Pendulum*, is cited merely as a concrete case of (1′).

Let ω be the earth's angular velocity. Let φ be the latitude of the place of observation. Resolve ω as shown in figure.



Then ω'' rotates the plane of the pendulum around a line in this plane, horizontal for the place. Hence ω'' produces no deviation. Obviously ω', the deviating component is $\omega \sin \varphi$.

In physical *meteorology* the same result enters fundamentally into the theory of cyclones. For if $2\,m\,V\omega$ be the deviating component of the earth's rotation for a circumpolar body of mass m and velocity V, then the corresponding component for any

latitude φ is $2\,m\,V\omega\sin\varphi$, quite independent of the azimuth of V.

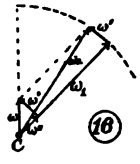
Again, if in figure (15) ω and ω_1 be replaced by linear velocities, one easily obtains by (8) the expression for accleration towards a center, etc.

Precession: In instruments like tops, gyroscopes, etc., the mechanism (supposed frictionless) is such as to *exclude all interference* from without, with the magnitude of the angular velocity ω of the top around its axis. This constructive condition is essential. Hence, if the axis changes position, and

(15)

if for brevity we suppose the tail of the arrow ω to remain frictionlessly at C, then the locus of the point of the arrow must be the surface of a sphere of radius ω. Let ω change in position to ω_1, let the axis to which the change of angular velocity ω' (in figure 15) corresponds, pass through C and necessarily rotate around it in a horizontal plane. This is clearly the case with the axis of gravitational torque in the precessional motion of a top or gyroscope. Then must ω' also lie in a horizontal plane, and the locus of ω is the surface of a circular cone with its axis vertical and its vertex at C. If ω' is imparted in unit of time ω' is the mean angular acceleration due to the gravitational torque and therefore equal to T/n by (12′). But the inclination of ω to the horizontal has just been shown to be constant (cone), wherefore gravitational torque is constant and ω' is constant. Hence the precessional motion is uniform rotation around the vertical axis of the fixed cone; for from one point of view ω' is the total change of angular velocity due to gravitational torque, and from another point of view, ω'/ω, constant for the reasons specified, is proportional to the uniform angular velocity of precession (see figure). If gravitational torque is withdrawn, as in a balanced gyroscope, $\omega'/\omega=0$ and precession ceases. If ω gradually decreases (friction), ω' will subtend a relatively greater angle, or precessional motion will be accelerated, even when the axis of ω is not lowered. In the latter case the result is accentuated, for gravitational torque is increased.

Again, suppose gimbals of a gyroscope *forcibly* rotated around a vertical axis. In Figure 16 let the angular velocity ω be thus



(16)

imparted in unit of time. Let ω_1 and ω_2 be the positions of the top axis and its angular velocities before and after the interference. Resolve ω into components ω' and ω'' respectively at right angles and parallel to ω_1. Then ω'' would rotate the top axis if it were not frictionlessly mounted. It actually rotates the gimbals only. Therefore $\omega_1 = \omega_2$ in length, as is otherwise evident. Thus ω' is the total effective change of angular velocity, and in virtue of this ω_1 passes to ω_2 and the extremity of the top axis rises, describing a circle in a vertical plane. If ω is imparted in a contrary direction the motion of ω_1 will be reversed. The top rolling on a blunt point belongs here.

Finally, if the top axis is forcibly rotated back and forth over a small angle around the *horizontal* axis of gravitational torque, similar considerations will lead to a better explanation of the curves drawn by a top on an inclined plane than I gave in a preceding article. The periodic changes of torque correspond to the rolling of the top up and down the inclined plane.

I have been tempted to enter somewhat at length into this most important subject,

because I failed to find an adequate account in such standard elementary text-books as came to my hands. Thus the explanation given in Daniell's physics is empiric and about within the limits of Perry's little book on tops. Ganot and Deschanel, Barker and Carhart, avoid the matter altogether. Kelvin and Tait's 'elementary' treatise has a single paragraph, intelligible at once, no doubt, to the authors. Peddie puts a slight expansion of this paragraph into his book. Even Violle's large new work says nothing about tops. In the German books, like Müller-Pouillet, Wüllner and the excellent treatise of Mousson, the phenomena are interpreted by aid of a suggestion of Poggendorff's, the very object of which is to dodge the principles of rotation involved under cover of a reference ('nur durch höhere Rechnung') to Euler. Yet gyrostats of diverse forms usually abound in physical cabinets. Supposing an instructor is not on the outlook for special entertainment for his children, of what use is such apparatus, I ask, if it be not to furnish the most striking tests imaginable of the truth of the above fundamental doctrines of rotation.

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PROVIDENCE, R. I.

ZOOLOGICAL NOTES.

NANSEN'S DISCOVERY OF THE BREEDING GROUNDS OF THE ROSY GULL.

OF the result of Nansen's Expedition thus far announced one of the most interesting, at least to ornithologists, is the reported discovery of the breeding grounds of Ross' Gull, also known as the Wedge-tailed or Rosy Gull (*Rhodostethia rosea*). In a letter published in the *London Daily Chronicle* last November, Dr. Nansen stated that he found flocks of Rosy Gulls on August 6th, in latitude 81° 38′, east longitude 63°. The birds were seen near four small islands called 'Hirtenland' by Nansen, a little northeast of Franz Josef Land. While Nansen did not actually find nests, he found the birds abundant, and concluded that their nests were probably near by. Every item of information regarding this rare bird is of interest, and in the December number of the *Ornithologische Monatsberichte* (pp. 193–196), Dr. Herman Schalow calls attention to the importance of Nansen's announcement and takes occasion to review briefly the history of the species.

There seems to be no reason to question the correctness of Nansen's determination of the birds or his surmise that they were breeding not far away. The wedge-shaped tail and the rosy tinge of the plumage (both noted by Nansen) are unmistakable characters of the species, and the presence of the gulls in such numbers in that high latitude renders it very probable that they were breeding. The Rosy Gull has long remained one of the rarest gulls. It was described from a specimen collected by Sir James Clark Ross in 1823, on Melville Peninsula, but in the next half century only a few individuals were taken and these in widely separated localities. In the autumn of 1881 Murdoch observed large numbers at Point Barrow, Alaska, apparently migrating from the west to the northeast. Although he secured a good series of specimens, he could add little to the life history of the species, and no other naturalist in Alaska has had the good fortune to meet with it in such numbers. This gull has also been taken in North America at St. Michael's, Alaska, and Disco Bay, Greenland, but it was not seen by the Lady Franklin Bay expedition. It was met with off the Siberian coast by the Jeannette Expedition, and was recorded by Payer between Nova Zembla and Franz Josef Land, only a few degrees to the south of the islands where Nansen found it.

The Rosy Gull is a typical arctic circum-

polar bird, reaching a latitude attained by few other species, and specimens taken outside the Arctic circle (at St. Michael's, Kamchatka, the Færoe Islands, Heligoland, and Yorkshire, England) can only be regarded as stragglers. No one has yet been able to explain what becomes of the thousands which pass Point Barrow in the autumn, and less is known of the winter home of this gull than of the region where it breeds. Murdoch supposed that its breeding grounds were somewhere north of Wrangel Island. Nansen's observations seem to indicate that they are much farther to the west, but, as Schalow remarks, "when will man's foot again tread the dreary wastes of those high latitudes where one of the greatest rarities of northern oology is to be found?"

T. S. Palmer.

Washington, D. C.

Origin of Parasitism in the Cowbird.

Reproductive parasitism, as we find it in our Cowbirds, is such a rare exception to the rule among higher animals, where parental affection is highly developed, that it never ceases to be an object of speculation as to its origin.

There are two peculiarities for which our Cowbird is renowned: The one which gives him his scientific name, *Molothrus*, a parasite; the other, which causes him to be called Cowbird, his strong attachment to grazing animals, especially horses and cattle.

Now, should there not be a connection between these two traits? Nobody would think that the habit of following horses and cattle has been formed since the introduction of these animals by the white man. Its Indian name, 'Buffalo-bird,' was certainly no misnomer, and it can hardly be questioned that for ages the buffalo, or American bison, was the animal which, in the economy of our cowbird, played the part now taken by the domestic animals. The distribution of the one coincides in the main with that of the other, except that in recent years the Cowbird has extended its range to follow domesticated cattle. A few years ago the bison roamed over the greater part of eastern North America from the Atlantic to the Rocky Mountains, in suitable places, and it was not until the last century that it became exterminated in the territory east of the Mississippi river.

But the habits of the Cowbird were probably formed before the bison and the Red Man were on the scene, since some species in southern South America have similar traits.

The Cowbirds, like all other Icteridæ, have their origin in South America, and of the twelve species and subspecies known only three enter the United States. Not all the species are parasitic; of some we do not know the mode of reproduction, but *Molothrus badius*, of Argentina, Paraguay and Bolivia, builds its nest and rears its young like other birds, and there was undoubtedly a time when *Molothrus ater* did the same.

We know that fossil remains of horses, not much unlike ours, are found abundantly in the deposits of the most recent geological age in many parts of America from Alaska to Patagonia. It was probably at that period that the Cowbirds acquired the habit of accompanying the grazing herds, which were wandering continually in search of good pasture, water and shelter, and in their seasonal migrations and movements to escape their enemies.

As the pastoral habit of the bird became stronger, it gave rise to the parasitic habit, simply because, in following the roving animals, the birds often strayed from home too far to reach their nests in time for the deposition of the egg, and, being hard pressed, had to look about for another bird's nest wherein to lay the egg.

After the acquisition of the roving habit,

it is not difficult to imagine that such cases occurred quite often, especially when, with the change of the climate, both birds and mammals spread more and more into the temperate regions where the spring movements of the grazing animals fell together with the bird's breeding time.

By a combination of favorable circumstances this new way of reproduction proved successful, and the parasitic offspring became more and more numerous. In the course of time the art of building nests was lost, the desire to incubate entirely gone, paternal and conjugal affection deadened, and parasitism had become a fixed habit.

O. WIDMANN.

CURRENT NOTES ON PHYSIOGRAPHY.

THE BRANCH STREAMS OF THE SCHUYLKILL.

MISS F. BASCOM recently discussed 'the relation of the streams in the neighborhood of Philadelphia to the Bryn Mawr gravel' (American Geologist, XIX., 1897, 50–57), with the object of determining the disputed age of the gravels from the amount of work done by the branches of the Schuylkill since the gravels were laid down. Wissahickon, Valley and Gulf creeks are explained as of superposed origin, because they flow at certain points transversely through narrow gorges in resistant strata. This conclusion tacitly postulates the occurrence of only longitudinal (subsequent) branch streams in the Schuylkill district before the gravels were spread over the region; it remains to be proved whether so perfect an adjustment of branch streams to structures is necessary. It is entirely conceivable that, before the gravels were deposited, the Cretaceous peneplain had some transverse streams, although most of its drainage may have well become longitudinal. Whether the Wissahickon could have maintained a transverse course so near the Schuylkill through both the Cretaceous and Tertiary cycles of denudation is certainly doubtful, but it has not been proved impossible. Gulf creek and its neighbors are so distinctly rectangular in pattern that adjustment and re-adjustment suffice to explain them without superposition. The elements of doubt and certainty are here so blended as to illustrate the dangers as well as the values of river analysis as a means of deciphering geological history.

HANN'S ALLGEMEINE ERDKUNDE.

THE Allgemeine Erdkunde of Hann, Hochsetter and Pokorny now reaches its fifth edition. The first part, treating the earth as a whole, the atmosphere and the hydrosphere being still prepared by Dr. Julius Hann (Vienna, Tempsky, 1896, 336 p., 24 colored plates and 92 figures), while volumes on the earth's crust and its forms by Brückner, and on the distribution of plants and animals by Kirchhoff, are promised for 1897. Hann's revised volume impresses one as a thorough work by a competent author, useful as a text for an advanced collegiate course, or as a reference book for advanced students. It is questionable whether various elementary facts, such as the obliquity of the ecliptic, the variation of the length of the day and its cause, and the weather-map facts as to cyclonic circulation, deserve a place in such a work; for any one who is competent to use the rest of the book should have been for some years familiar with these fundamentals. The more serious subjects may be inferred from a rapid review of the contents; the size and shape of the earth, and their consequences in the variation of gravity and the determination of positions; terrestrial magnetism and auroras; the atmosphere, its temperature, pressure, winds, moisture, rain and weather—with less attention to the origin of cyclones than would be welcome; the ocean, its depth, composition, temperature—this treated in much detail—

currents, waves and tides. The book may be strongly recommended for a professor's library.

THE GEOGRAPHICAL ASSOCIATION.

A NUMBER of English schoolmasters have formed a Geographical Association, 'to improve the teaching of Geography in secondary schools by adopting any methods that tend to the comprehension of geographical principles rather than the accumulation of isolated facts.' The prevalent backward condition of the study in England can be inferred from the publication of an essay on 'Geography as a school subject,' by the Hon. Secretary, B. B. Dickinson (Lawrence, Rugby, 1896), 'an attempt to show that geography can be taught as a training of the mind.' It is curious to note that the element of training, as far as it is illustrated in this essay, is almost entirely derived from a consideration of climate, and that no disciplinary value is assigned to the study of land forms themselves. The treatment of the winds, under climate, is unsatisfactory; for example: "It can be explained in simple language that one effect of [the earth's] rotation will cause the atmosphere to be heaped up relatively high over the equatorial regions and low over the poles, and that this would lead to a gradual increase in the atmospheric pressure on the surface of the earth as we proceed from the poles to the equator." Again: "The pupils should carefully note how gradual is the falling-off of the heat received in the first 45° [from the equator], and how rapid it becomes with greater obliquities." Both quotations contain errors of statement that are inconsistent with good training. On the other hand, the attempt to connect human conditions with physical conditions is admirable; so admirable, indeed, that it should be uniformly extended all through the study of geography with as much care as is here given to the chapter on climate.

NOTES.

'THE Missouri river and its utmost source' is the title of a book by J. V. Brower (St. Paul, 1896), already known by his studies of the source of the Mississippi. This newer volume contains a little in the way of observation on the ground, but it is confused with a quantity of irrelevant matter, both in text and illustration. The text has less of physiographic matter than might be inferred from the title.

PROFESSOR A. A. WRIGHT, of Oberlin, has recently addressed the Ohio Academy of Science on the importance of establishing a topographic survey of that State. The educational, as well as the technical, value of the survey is emphasized, and a joint undertaking with the U. S. Geological Survey is recommended. The Academy approved the plan and appointed a committee of three to secure favorable action by the next Legislature.

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CURRENT NOTES ON ANTHROPOLOGY.

THE GAME OF MANCALA.

THE value of games, both as marking distribution within certain areas and as illustrating analogous lines of independent development, has been a fruitful study in the hands of Mr. Stewart Culin, of the Museum of the University of Pennsylvania.

His latest contribution is entitled 'Mancala, the national game of Africa,' and appears in the last Report of the United States National Museum (pp. 10, with illustrations). He believes that "it marks the limits of Arab culture," or, rather influence, and was historically disseminated by the extension of this Semitic people. He describes the modes of playing it and comments on its historical spread. It seems to have been known for some years in the United States under the name 'chuba.'

ORIENTAL ITEMS OF ETHNOLOGIC INTEREST.

THE seventeenth volume of the Journal of the American Oriental Society contains several articles of ethnologic interest. One is the date of Zoroaster, which fixes the definite form of the Mazdeistic cult. This is placed by Prof. A. V. W. Jackson, in a very erudite analysis of the testimony, 'between the latter half of the seventh century and the middle of the sixth century B. C.'

Dr. John P. Peters defends with strong arguments the opinion that "the original home of civilization in Babylonia was the strip of land from Nippur southward to the neighborhood of Ur," and the founding of the city of Nippur "considerably antedated 6,000 B. C. and perhaps 7,000 B. C." That there were city builders among men that long ago is a most interesting result.

Prof. Haupt, in a critical analysis of the Judaic account of creation, adds to the evidence that it is 'specifically Babylonian' in origin.

Dr. C. P. G. Scott has some remarks on the 'universal' qualities of language, apropos of Malayan, a subject of the greatest anthropologic interest.

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NOTES ON INORGANIC CHEMISTRY.

IN a recent number of the Zeitschrift für physikalische Chemie, Debus criticises some of the conclusions of Roscoe and Harden in the 'New Views of Dalton's Atomic Theory.' He holds that in 1801 Dalton was led to the hypothesis that equal volumes of gases under normal conditions contain equal numbers of molecules, and that this hypothesis and his study of the oxids of nitrogen led him to formulate his atomic theory. In 1805 he abandoned his earlier views as to the equal number of molecules. Avogadro was probably aware of Dalton's views and borrowed his hypothesis, which is now known as Avogadro's law.

To the number of metallic carbids produced in his electric furnace by Moissan must now be added lanthanum carbid, C_2La. It is, like most of the other carbids, decomposed by water and yields chiefly (71%) acetylene with 27% methane, a little ethylene and small quantities of liquid and solid hydrocarbons, thus closely resembling the carbid of cerium.

THE last Proceedings of the Chemical Society (London) contain accounts of experiments of E. Sonstadt on sea water. As long ago as 1872 Sonstadt showed that the iodin in sea water is in the form of calcium iodate, four parts per million. His experiments not having been repeated by others, he now shows that an oxidizing substance must be present in sea water. He compares the oxidizing action of sea water on ferrous sulfate with that of sea water which has been deprived of iodates and similar compounds by evaporation and heating with mercury. He finds that the oxidizing quality of sea water is far greater than would be due to the presence of the iodate, and infers that other oxidizing substances are present. It seems ordinarily to be taken for granted that iodin is present in sea water as sodium iodid, analogous to chlorin and bromin, but, aside from Sonstadt, Balard and Pfaff are the only observers who have been able to even detect the presence of iodin in any form in sea water.

Sonstadt also shows that silver and gold can be detected in as small quantities as two liters of sea water, by continued agitation with mercury. The mercury on evaporation leaves a film partly soluble in nitric acid showing silver, while the insoluble portion dissolves in aqua regia and on cupellation gives a very minute bead of gold. Sonstadt concludes that, inasmuch as silver chloride is not decomposed by mercury, the silver may be considered to be present practically as metallic silver, and the gold probably in a similar condition.

H. N. Warren contributes a short article to the *Chemical News* on calcium carbid as a new reducing agent. He finds that when it is heated with many metallic oxids they are reduced, forming generally alloys of the metal with a small amount of calcium. Even the oxids of chromium, molybdenum and uranium are readily reduced. Calcium carbid, which is so cheap, may come to replace for reduction the more expensive sodium or potassium.

M. Guntz, to whom has just been awarded the Saintour prize of the French Academy of Sciences, shows in a recent Comptes Rendues that the lithium nitrid obtained by him is not pure. Lithium combines directly with nitrogen, but the nitrid on formation dissolves a portion of the substance of the vessel in which the lithium is contained. Iron is least readily attacked; silver, platinum, quartz and graphite-carbon are readily acted upon, and cannot be used; hence all of the lithium nitrid formed is more or less contaminated by foreign matter. J. L. H.

ASTRONOMICAL NOTES.

The Nichols Press, of Lynn., Mass., has published a large quarto volume of 258 pages by Dr. T. J. J. See, entitled 'Researches on the Evolution of the Stellar Systems.' Dr. See gives a comprehensive account of the present state of our knowledge of the binary systems, and, while he includes but little matter which has not already appeared in print, he has produced a book which will certainly be of great interest to students of the subject.

The volume contains excellent accounts of the methods in use for the determination of binary star orbits, as well as reprints of Dr. See's own recent articles published in the *Astronomische Nachrichten*. These articles relate to the use of spectroscopic observations for the study of the binary stars and for the application of a rigorous test of the universality of the law of gravitation. They have been criticised in the same journal in which they appeared, but in the present volume no notice is taken of these criticisms. Following the theoretical introduction, Dr. See gives his determinations of the orbits of forty stars, together with the observations on which they are based. We have not space to enter into a detailed criticism of this part of the book, but we are not sure that Dr. See's methods will meet with the complete approval of astronomers in general. Thus in the case of Zeta Sagittarii, Dr. See says: "While in Virginia recently I took occasion to measure this star, and, although the object was seen with difficulty, owing to its low altitude, I could discover a distinct elongation in the direction 194°.7; the distance could not be fixed with much confidence, but my settings of the micrometer gave 0″.35. The estimates of distance were substantially the same, but I am now convinced, from my distinct recollection of the appearance of the object, that both the measure and the estimate were too large." We doubt whether recollections of the appearance of a double star should have any place in the discussion of an orbit. Another thing which students might expect in the present work is a series of extended ephemerides computed from the orbits given by the author. But the ephemerides usually extend for a year or two only, and this circumstance will diminish somewhat the practical usefulness of the work.

The observatory of Karlsruhe has issued the fifth volume of its publications. We find in it observations of stars south of the equator, made during the years 1892 to 1894, together with a catalogue derived from them. This volume is the last which will be issued from Karlsruhe, as the observatory has been moved to Heidelberg, where new buildings have been erected on one of the hills overlooking the Neckar valley.

WE have received the *Annuaire du Bureau des Longitudes* for 1897. It contains the usual mass of interesting statistical matter and a series of 'Notices' of more than usual interest. Three of the latter are by the late Professor Tisserand. They are entitled:

1. On the proper motion of the Solar System.

2. On the fourth meeting of the International Committee for the photographic chart of the heavens.

3. On the meeting of the International Committee for fundamental stars.

These notices by Tisserand have a sad as well as scientific interest, for they are followed by the orations delivered at his grave by Poincaré, Janssen and Loewy.

There is also a notice by Poincaré on the Röntgen rays, and one by Janssen on 'Epochs in the Astronomical History of the Planets.' These notices are not technical in character, and all are very interesting. The volume can be obtained for 30 cents, and should be in the hands of all persons interested in any department of astronomy.

WE note the appearance of the British Nautical Almanac for the year 1900. It is in all respects similar to the volume for the preceding year. In glancing over the preface of the work one cannot help noticing how small has been the use made of the theoretical researches of British astronomers. Probably not one formula or constant of importance is taken from a published research of English origin. And where results depend on observational series made in England these results are generally taken from discussions of the English observations by foreign astronomers. It is a truism that science is international, but truisms do not always penetrate government offices. The course of the British authorities must be highly commended, for they have used what they thought was best for science, without regard to the nationality of its origin. H. J.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR SIMON NEWCOMB and Lord Kelvin have been elected honorary members of the St. Petersburg Academy of Science. Lord Rayleigh and M. Callandreau have been elected corresponding members.

DR. ARTHUR AUWERS, the Berlin astronomer, has been awarded a gold medal by the German Emperor.

PROFESSOR JOSEPH LE CONTE, after attending the meetings of the American and British Associations for the Advancement of Science, and the autumn meeting of the National Academy of Sciences, and presiding over the annual meeting of the Geological Society of America, went to Milledgeville, Ga., and, at the place where he was married fifty years ago, surrounded by friends and relatives, including Professor W. Le Conte Stevens, he celebrated, on January 14th, his golden wedding. Professor Le Conte has now returned to the University of California. Although seventy-four years of age, Professor Le Conte retains all the energy and originality in research, publication and teaching which, during the past fifty years, have accomplished so much for the advancement of science.

HEINRICH GÄTKE, the veteran ornithologist, of Heligoland, died on January 1st, at the ripe age of 83. He is best known from his great work on Bird Migration, which contains the results of more than half a century of close observation at a single point—the rocky islet of Heligoland, in the North Sea. This small island is situated at a point where two great lines of migration meet, and is the most favorable spot known in the world for studying the periodic movements of a very large number of birds. Gätke's work is chiefly valuable as a record of facts of observation; his deductions are not accepted by most American students of migration.

THE deaths are announced of Isidore Strauss, professor of experimental pathology, at Paris, and known for his important contributions to our knowledge of contagious diseases and bacteriology; of Jean Hubert Thiry, formerly professor of surgical pathology in the University of Brussels; of Dr. George Weyer, professor of mathematics and astronomy at the University

of Kiel, and of T. P. Morawitz, the entomologist of St. Petersburg.

We are glad to learn that Sir Joseph Lister, on being raised to the peerage, has selected the title of Lord Lister and will thus retain the name which he has made eminent.

The German Emperor has conferred an order of the crown on Professor Linde, of the Polytechnic Institute at Charlottenberg.

The Kansas Academy of Science, at its recent annual meeting at Topeka, placed the name of Chaplain John D. Parker on the roll of life members, as a recognition of his effective services in organizing science in the West. During the past thirty years he has been one of the founders of the Kansas Academy of Science, Kansas City Academy of Science, Nebraska Academy of Sciences and California Science Association.

The budget of the Prussian government appropriates 50,000 Marks for investigation on the Röntgen rays. The money is to be used for apparatus to be divided into a number of special appropriations.

The New York Aquarium at Castle Garden is visited daily by 7,000 people. This large attendance demonstrates the usefulness of such institutions for purposes of instruction and healthful amusement. It is understood that Mayor Strong is in favor of setting aside the land at Bronx Park for the Zoological Park, and it is much to be hoped that arrangements may be carried out without too great delay.

A dispatch from Teheran says that 2,500 persons perished as a result of the earthquake which occurred on Kishm Island, in the the Persian Gulf, January 11th.

The Friday evening meetings of the members of the Royal Institution are announced to open on January 22d, with a lecture by Professor Dewar, on 'Properties of Liquid Oxygen,' to be followed on the 29th by a discourse on 'The Polarization of the Electric Ray,' by Professor J. C. Bose, of Presidency College, Calcutta.

The Geological Society of London will, this year, award its medals and funds as follows: The Wollaston Medal to Mr. W. H. Hudleston; the Murchison Medal and part of the fund to Mr. Horace B. Woodward; the Lyell Medal and part of the fund to Dr. G. J. Hinde; the Bigsby Medal to Mr. Clement Reid; the proceeds of the Wollaston fund to Mr. F. A. Bather; the balance of the proceeds of the Murchison fund to Mr. S. S. Buckman; and the balance of the proceeds of the Lyell fund to Mr. W. J. Lewis Abbott and Mr. J. Lomas.

The forty-fourth annual meeting of the American Society of Civil Engineers was opened in New York on January 20th, under the presidency of Mr. T. C. Clarke. The Norman Medal was awarded to Mr. J. E. Greiner for a paper entitled 'What is the Life of an Iron Railroad Bridge?' and the Rowland Prize to Mr. H. S. Coppee for a paper entitled 'Bank Revetment on the Lower Mississippi.' Mr. B. M. Harrod was elected President of the Society for the ensuing year.

The building of the Bellevue Hospital Medical College, New York, was injured by fire on January 20th. The damage to the building is estimated at $15,000, and much apparatus has been destroyed.

The United States Civil Service Commission will hold an examination in Washington and in other cities where there are applicants, commencing on February 10th, to fill a vacancy in the position of expert horticulturist, office of experiment stations, Department of Agriculture, the salary of which is $1,400 per annum.

Professor Giuseppe Sanarelli, Director of the Uruguayan National Institute of Experimental Hygiene, has reported, to the Academy of Medicine in Rome, the discovery of the bacillus of yellow fever. He will shortly publish the result of his experiments.

The New York Board of Health has declared pulmonary tuberculosis, or consumption, an infectious and communicable disease, dangerous to public health. The resolution adopted by the Board ranks consumption with diphtheria and measles. The resolution makes it the duty of every physician to report minutely within one week to the sanitary bureau of the Board, concerning everyone sick with consumption whom he attends or who comes under his observation. Further, it orders every consumptive in the city, and every person attending a

consumptive 'to observe and enforce all the sanitary rules and regulations of the Board of Health for preventing the spread of consumption.'

RECORDER GOFF, of New York, in speaking recently before the Medico-Legal Society, called attention to the very unsatisfactory condition of expert testimony before courts of justice. He had observed that juries were universally sceptical in regard to such testimony. He said that he would favor the establishment of a board which would select men who would be qualified to serve as experts.

A NEW quarterly journal, *Archives d'anatomie microscopique*, is announced by Masson et Cie. It will be under the direction of MM. Balbiani and Ranvier, and M. Henneguy will act as managing editor.

WE have already announced the new journal, *Monatschrift für Psychiatrie und Neurologie*, edited by Professors Wernicke and Ziehen. The first number has now been published at Berlin.

La Nature, the French weekly journal of popular science, will hereafter be edited by M. H. Parvil in place of M. Gaston Tissandier, who for twenty-five years has been its editor.

PROFESSOR JAMES SETH has become one of the editors of the *Philosophical Review*, published by Ginn & Co. for Cornell University,

REUTER'S agency states that two Danish officers, MM. Oloufsen and Philipsen, have just arrived in St. Petersburg on their return from a journey of exploration to the Pamir country, where they reached places hitherto untrodden by Europeans. They have brought back with them over 300 photographs of places they have visited and types they have met. During their travels they met, among others, tribes who are still fire-worshippers and totally uncivilized in their mode of life. The men of these tribes, and even their animals, are of very small size, the bulls and cows being no larger than a European foal, the donkeys about the size of a large dog, and the sheep about as large as a small poodle. The use of money is unknown to them, and their only trade consists in the bartering of furs. Women are bought at the rate of five or six cows or fifteen sheep apiece. These natives are very timid, and on the approach of strangers take to flight. MM. Philipsen and Oloufsen have secured numerous scientific collections, which they intend presenting to the Natural History Museum in Copenhagen, and have also made interesting meteorological observations. In the course of their voyage they occasionally reached a height of 14,000 ft. above the level of the sea.

ACCORDING to the London *Times* an electric omnibus, belonging to the London Electric Omnibus Company and propelled by electricity on the Radcliffe Ward system, has made a successful trial trip. Starting from Northumberland Avenue, it was able to ascend the comparatively steep slope of St. Martin's lane without any difficulty, although it was loaded with all but the full number of passengers it is constructed to carry and the streets were far from being in a good condition. In the crowded traffic of Oxford street it showed itself to be perfectly under the control of the driver as regards both steering and speed. It easily threaded its way among other vehicles and its pace could be regulated at will to pass almost everything else on the road or to crawl along with the slowest, while its powerful brakes enabled it to be pulled up dead within a yard or two. The pneumatic cushions interposed between the frame and the car do much to diminish vibration, and the smoothness and easiness of the running are in marked contrast to the uneasy rumble which usually accompanies London omnibuses.

THE results of the quinquennial census of France, taken on March 29, 1896, show a population of 38,518,975, an increase of 125,027 during the five years. The towns having more than 30,000 inhabitants show an increase of 320,000. Most of the agricultural districts, with the exception of Brittany, show a decrease.

THE London *Times* reports that the Council of the Royal Colonial Institute, for themselves and on behalf of about 4,000 Fellows of the Institute residing in all parts of her Majesty's dominions, have forwarded to the Prime Minister a memorial urging on the government the advisability of taking early steps for the unification

of time at sea, a question which has been brought under the consideration of the Council by the Royal Society of Canada. The memorialists say that the various points connected with civil, nautical and astronomical time at sea appear to have been fully gone into during the past twelve years by various societies and authorities in different countries, and to have been eventually resolved into the simple question of the desirability of advancing astronomical time by twelve hours so as to harmonize it with civil time, for nautical time has in general practice long been assimilated to civil time, and is no longer a matter giving rise to difficulty or discussion. It is believed by the memorialists that the proposed change can be easily introduced with decided advantage to observers, and that the general principle of the unification of time at sea has now an almost universal consensus of opinion in its favor. The advancement of astronomical time by twelve hours so as to assimilate it to civil time, in order that both may be in agreement and begin everywhere at midnight, would require the adaptation of the 'Nautical Almanack,' to the change, and as the 'Nautical Almanack' is of necessity prepared some years in advance, it is submitted that a decision should be arrived at by her Majesty's government with as little delay as possible, in order that the change may take effect at the date indicated by astronomers—viz., the first day of the new century.

The general report on the operations of the survey of India during the year ending with September, 1895, according to *Nature*, shows that in this period the aggregate area surveyed on all scales amounts to 125,384 miles, exclusive of 5,018 square miles embraced by traverse operations in the central provinces and the northwestern provinces and Oude. In the trigonometrical surveys the Upper Burma principal triangulation was carried northwards as well as westwards through Manipur and Assam. In addition to the topographical work accomplished during the year, a detachment with the Pamir commission surveyed 250 square miles, and one with the Chitral relief force surveyed in detail 450 square miles on the 1-inch scale, 215 square miles on the ½-inch scale, and, approximately, 1,900 square miles on the ¼-inch scale. The results of the operations of the latter surveyors is that considerable knowledge of the topography has been gained of an area of 3,600 square miles of a country previously practically unknown, and much credit is due to Captain Bythell and the men who served under him for such a satisfactory record of work. Two views, representing the Malakand Pass and the Chitral bridge and fort, have been reproduced by heliogravure to illustrate Captain Bythell's report. A mass of information on the forest survey operations, cadastral surveys, traverse surveys, longitude observations, geographical surveys and reconnaissances, carried out by the survey department under the direction of Colonel C. Strahan, R.E., Surveyor-General of India, is included in the general report.

Mr. George F. Kunz, in his report to the United States Geological Survey on the productions of precious stones in 1895, states that among the more interesting occurrences and changes in precious stones for the year 1895 may be mentioned: (1) the finding of a 6-carat diamond at a new locality, Saukville, Ozaukee County, Wis.; (2) the diligent search made for monazite in North Carolina and Georgia, resulting in the finding of a number of interesting gems; (3) continued finding of rubies near Franklin, Macon County, N. C.; (4) the discovery of true blue sapphires near Utica, Fergus County, Mont.; (5) the discovery of some remarkable gem tourmaline of extraordinary size and wonderful perfection at the historic Paris Hill locality, Oxford County, Me.; (6) the finding of a large quantity of fine chrysoprase in Tulare County, Cal.; (7) the discovery of an enormous crystal of tourmaline on New York Island; (8) the interesting exhibition of Southern gems at the Cotton States and International Exposition, at Atlanta, Ga., and the presentation of this collection to the Lea collection at the United States National Museum; and (9) the opening of the Golden Gate Park Museum, at San Francisco, with an interesting collection of gems. Among foreign occurrences may be noted: (1) the increased yield of the South African diamond fields and the absorption of the entire yield by the gem markets of the world; (2) the occurrence of rubies of good color and in some abundance in various fields

in Siam; these are very rarely equal to the Burmese, yet they are fine stones, and, although generally much lower in price, a single stone sold for more than $1,000; (3) the great profusion and beauty of the opal and the large demand for these stones, which were produced in greater quantity, finer quality and at a somewhat lower cost than ever before from the fields at Fermoy, Queensland, and in the new locality at White Cliff, in New South Wales.

THE article by Dr. Dabney in the issue of this JOURNAL for January 15th, pointing out the advantages of a National Department of Science, was prepared at the suggestion of Hon. Gardiner G. Hubbard, who wrote to Dr. Dabney as follows:

1328 CONNECTICUT AVE.,
WASHINGTON, D. C., January 3, 1897.

DR. CHARLES A. DABNEY, JR., *Washington, D. C.:*

DEAR SIR: My attention has been called at different times during the past year to the great number of scientists employed by the government and the large amount of appropriations. I have also observed that the same subject seemed to be treated often under two and sometimes under three departments, thus leading to needless duplication of labor.

I know that your attention has been somewhat called to this subject. I, therefore, venture to ask you, if your time will permit, to prepare an article for publication, which shall bring out fully all these facts, and also suggest a remedy which would seem to be the placing all this scientific work under one department. I know of no one better fitted than yourself to perform this work and am sure that it will be carefully and correctly done.

Very truly yours,
GARDINER G. HUBBARD.

HON. CHARLES W. DABNEY, JR.,
Assistant Secretary of Agriculture.

UNIVERSITY AND EDUCATIONAL NEWS.

THE New York Court of Appeals has decided the Fayerweather will case by affirming the judgment of the lower court. The residuary estate, now amounting to more than $3,000,000, will consequently be divided equally among the twenty colleges named in the will. The following institutions will each receive more than $150,000: Amherst, Bowdoin, Dartmouth, Williams, Yale, Columbia, Hamilton, Lafayette, Lincoln, Maryville, Marietta, Adelbert, Wabash, Park, Wesleyan, Rochester, Cornell, Virginia, Hampton, and the Union Theological Seminary.

A NUMBER of professors of the University of Berlin have asked permission from the Senate to inaugurate a system of university extension lectures. It appears, however, that there is considerable opposition to the plan in Germany, in part because it is supposed that many university professors might favor the views of social democracy.

ACCORDING to the new *Prussian Budget* professors in the University at Berlin will receive an increase of salary of $500 Marks, and smaller increases in salary are granted to professors in the other Prussian universities and to teachers in the schools.

MR. HAROLD HEATH has been appointed fellow in biology and Mr. J. M. Mathews fellow in chemistry in the University of Pennsylvania.

DR. E. WIECHERT, docent at the University of Konigsberg, has been promoted to a professorship. Dr. Willstätter, of Karlsruhe, has qualified as docent in chemistry in the University at Berlin.

DISCUSSION AND CORRESPONDENCE.

SIMPLIFIED SPELLING.

TO THE EDITOR OF SCIENCE: In a book notice sent to you to-day you will observe two instances of the innovation in spelling proposed by Funk & Wagnalls. Instead of 'grouped' and 'addressed,' I have written 'groupt' and 'addrest.' Unless special instructions are given, your compositor and proof-reader will ignore my attempt at reform and print these words according to the prevalent fashion. Of this I cannot complain, for it is certainly the privilege of a journal to unify its pages in the matter of spelling. Neither am I disposed to criticize SCIENCE for not joining in the spelling-reform movement, for it would be unwise for a journal with its own battles to fight to incur the odium which attaches to rational spelling. The prejudices in favor of irrational spelling are so strong and prevalent that they cannot be opposed without a certain measure of sacrifice on the part of the opponent. Nevertheless, it seems to me that SCIENCE may, without harm to itself, allow such of its contributors as have

joined in the Funk & Wagnalls' movement to reform their participles in signed articles, and I, therefore, submit a request for permission.

G. K. Gilbert.

Washington, D. C.,
January 18, 1897.

An Explanation of the So-Called Pseudo-Aurora.

Occasionally, during the winter season, dwellers of our Northern cities have noticed by night a strange optical phenomenon, which some one has called the 'pseudo-aurora,' and which, so far as I know, has not been heretofore explained.* My attention was first called to it some years ago, in Moorhead, Minn. Over each arc lamp, used in street lighting, appears a strange column of pure white light, seeming to extend vertically to a great height; a peculiar transparent shaft, like the brightest bars of the aurora borealis, yet standing very still, and always vertical over the lamp from whatever point viewed. When each arc lamp in the whole town is thus attended by its vivid shaft the display is magnificent and, seen against the northern sky, might easily suggest the 'pseudo' name. On an evening of special beauty these columns seem to reach almost to the zeinth, and other sources of light add their shafts to the display. The evening star gives a shaft below as well as above, and the late rising moon stands right *in* a broad column of light.

Looking about for causes, and noticing from time to time the conditions under which this meteor appeared, the following facts were observed: The temperature is always below the freezing point, oftenest about zero. The sky is cloudless, air still or barely moving, and more or less full of frost crystals. The display is finer, completer, when most crystals are present, though by no means does the mere presence of crystals in the air furnish the spectacle. The shafts of light are most sharply defined and apparently higher when the air is stillest. With more wind the shafts spread out, diffuse, becoming indistinct, and with a gentle breeze the light seems to be more or less evenly distributed through the entire upper air, like a fine luminous dust suspended there.

*See Loomis's *Meteorology*, p. 224.

Having noticed these conditions, it is apparent that the crystals are the important factor, and reflection of light from their facets is suggested at once. Of course to get a vertical shaft of light by reflection necessitates a constant horizontal position of the crystal faces, and I searched long and arduously for a ballasted crystal, floating like a parachute, but found none. What I did find in each case was a minute hexagonal plate of solid ice, in no case more than one millimeter in diameter, extremely thin, and of glassy smoothness.

I experimented with this idea: Making some hexagonal plates an inch across, of the lightest glazed bond paper, and letting them fall in still air from a height, the whole story is told. Each plate floats gently down, at times making a rapid chute edgewise, but quickly recovering a horizontal position, so that of all the time involved in falling, the larger part is taken up while the plate is in a position approximately horizontal. We have seen the same thing in autumn when the great basswood leaves let go and float slowly down.

Now, filling the air with such plates, each of which is a perfect mirror, we have in the vertical plane, between our eye and the light, innumerable crystals, from the lower surface of which rays of light from the lamp are reflected to our eye, and seen by the eye as though located in the straight line in which they enter the eye, and at a distance equal to the distance traveled from the lamp. This gives the vertical column, the location of any single point in it being shown by construction, the same as an image in a plane mirror.

The little crystal plate adjusts itself, like a flat stone at the bottom of the torrent, or a cake of ice at the top of the sea, with its broad surface normal to the force acting upon it. So long as this force is gravity only, the position of the crystal is horizontal. But if the wind be blowing this adds a horizontal component, giving with gravity a resultant no longer vertical, to which the plate becomes normal. With the departure of the crystal from the horizontal position the vertical shafts of light disperse.

J. Paul Goode.

University of Chicago.

SCIENTIFIC LITERATURE.

Catalogue des bibliographies géologiques. Rédigé, avec le concours des membres de la Commission bibliographique du Congrès. Par EMM. DE MARGERIE. Paris, Gauthier-Villars et Fils. 1896. Pp. xx + 733.

The International Geological Congress, at its Washington meeting in 1891, appointed a standing committee on bibliography. The original membership was ten, but provision was made for enlargement by the committee itself, and there were eventually fourteen members, representing the principal countries or regions having geologic literature. North America was represented by Mr. Gilbert, and South America by Dr. Steinmann, of Freiburg, Baden. The duties of the committee, as instructed by the Congress, were: (1) to prepare and publish a list of existing partial bibliographies of geology; (2) to promote the preparation by geologic societies and surveys of bibliography pertaining to their respective territories, and (3) to study the problem of the systematic centralized publication of the current bibliography of geology. The first of these works was immediately undertaken and has resulted in an imposing volume of 750 pages.

When a cooperative work of such magnitude is carried to a successful conclusion there is usually some one individual to whose skill and energy the success is due, and in this instance that person was M. Emm. de Margerie, of Paris, the Secretary of the Committee. Under his guidance the other members of the committee gathered material from their respective countries or districts, but the whole was classified, unified, and eventually in large part verified through comparison with original sources by him. He, moreover, made a systematic search of libraries and was thereby enabled to make large additions to the list.

The whole number of entries is 3,918 and these are groupt under two 'parts' and many headings. The first part, with various subdivisions, includes bibliographies whose geographic scope is either the whole earth or one of its greater divisions. The second part includes the bibliographies of regions or countries, arranged alphabetically by regions. The regional entries are also classified according to scope and subject, and there are abundant of cross references. This elaborate classification adds greatly to the convenience of the book, enabling the user to find in one place, or at most in two or three places, all references to any special subject of inquiry. His convenience is further consulted by the addition of three indexes, referring severally to authors, places and topics. The scope and method of each work listed, when not described in its title, are explained in the annotation.

A summary of the part pertaining to North America (United States and Canada) will at once illustrate the scope of the list and its mode of classification. General bibliographies afford 12 titles; catalogues of publications of official surveys, 33; general indexes of transactions and journals, 10; annual bibliographies, 9; library catalogues, 3; personal bibliographies and biographic notices, 51; bibliographies of special districts, 61; subject bibliographies, 70, of which 52 pertain to special formations, 1 to paleontology and 9 to petrography.

While the primary purpose of the committee was to take an account of stock in the field of geologic bibliography, and thus pave the way for the most intelligent undertaking of systematic and comprehensive work for the future, their catalogue has an immediate value to the investigator as a directory to the places where the literature he wishes to examine is listed.

The chief cost of publication was met by the local committees of the Washington and Zurich Congresses, and copies of the volume have been forwarded to the geologists who attended those meetings. This distribution has not entirely exhausted the edition, and the remaining volumes are placed on sale, the price for the United States and Canada being $5.00. The Secretary of the Washington Congress permits me to add that the Compte Rendu of that meeting will be forwarded without cost to the American purchasers of the Catalogue. Correspondence should be addrest to

GEOLOGICAL SURVEY, G. K. GILBERT.
WASHINGTON, D. C.

The Principles and Practice of Teaching. JAMES JOHONNOT. Revised by SARAH EVANS JOHONNOT. International Education Series, Vol. XXXIX., 12mo., pp. xx+334. D. Appleton & Co., New York. 1896.

Nature Study and Related Subjects for the Common Schools. Wilbur S. Jackman, A. B. Part I. Charts, 4to, pp. 23; Part II., Notes, 12mo., pp. 167. The Author, Chicago. 1896.

These two books are of especial interest to teachers of science, for, even though the first is concerned with teaching in general, the author, nevertheless, lays especial stress upon the proper methods of science teaching. Although Johonnot's book originally appeared nearly twenty years ago, this revised edition seems fresh and new, not because there is much new matter incorporated in it, nor yet because the subject-matter has been materially changed, but rather because the original work contained so much that was true in principle and clear in expression. The system is based upon sound psychological principles and the book is a clear exposition of the scientific method of teaching. It contains chapters upon the general objects of education, the mental powers, objective and subjective courses of instruction, relative value of different branches of instruction, Pestalozzi, Froebel, Agassiz, systems of education compared, physical, æsthetic and moral culture, general course of study, country schools and their organization.

The most noticeable changes made by the reviser are in relation to manual training, moral culture and general courses of study, and are all in the direction of recent pedagogical opinion on these subjects. An appendix is added, giving an account of a school conducted upon the principles advocated by the author. Of his success we may judge from the following extract:

"Our experiment came to an end. Of the various innovations made upon custom each had justified itself. The effort to make character the end of education had more than fulfilled expectation. During the last year not a single case of misconduct was reported to me, nor was the behavior of one of our students criticised by the citizens. We had a reign of influence. The forces that govern conduct came from a growth within of just and kindly impulses. A watchful supervision had always been maintained, but into this had entered no element of espionage. The peculiar character which the school attained, both on its mental and moral side, was due to the several factors of influence—scientific methods in study, philosophic succession of subjects and a never-ceasing but an apparently *incidental* attention to moral training."

Prof. Jackman's work consists of two parts, the first being a set of ten charts presenting a conspectus of nature study for the school year, and the second a series of notes and directions for the guidance of the teacher. The charts outline the subjects of study appropriate for each month of the school year from September to June inclusive, the subjects themselves being mineralogy, geology, astronomy, meteorology, chemistry, physics, geography, botany and zoology. Each subject is considered in the two aspects of thought work and form work. Under the former are included the subject, both general and special; the concept, to be considered from the study of the subject; collections illustrating the subject; apparatus required; reading from certain designated books containing selections for school use; literary treatment of the topic by recognized writers; the moral and æsthetic culture derived from the study. Under the head of form work the pupil's training is directed along the lines of the study of the geometrical form exhibited by the object; number, consisting mainly of statistics gathered by examining a large series of objects and bearing on various points; making or modeling the object or the piece of apparatus used; drawing the same; color, as shown in nature; writing upon some topic suggested by the thought work; language, including the study of descriptive phrases, figures of speech, technical terms, etc.; music, as illustrated by the appropriate school songs; references to standard scientific literature.

This plan of study as outlined above will at once be recognized as that of a teacher who has had long experience and has been guided by correct principles; of one who evidently believes that nature study develops something more than the powers of observation, and if properly conducted may be the means of cultivating all the mental faculties. The plan itself is exceedingly comprehensive and varied. In the hands of a conscientious and well-trained

teacher it ought to give admirable results. Each subject is considered from so many points of view that it seems scarcely possible that the pupil could lose interest in the work or fail to see the intimate relation between the great number of natural phenomena and the daily affairs of life. The pupil's attention is held throughout the course of study by interesting him in some aspect of nature especially noticeable during the different seasons. To illustrate, the plan contemplates the following subjects for study during the month of October: In zoology, the migration of animals; in botany, the distribution of seeds; in geography, areas of crops sown in the autumn; in physics, evaporation and condensation; in chemistry, ash, organic matter, fluid and dry solid in common fruits; in meteorology, rainfall and humidity; in astronomy, distribution of sunshine; in geology, erosion and sedimentation, the transporting power of water; in mineralogy, evaporation of water from the soils, and sand and granite.

The notes composing Part Two of the work, though, perhaps, rather too rhetorical in treatment, present to the teacher directions for the construction and use of apparatus, descriptions of experiments and suggestive examples illustrating the tremendous scale upon which the operations of nature are conducted. While in most cases the directions are sufficiently explicit, much is left, and properly, too, to the individual teacher to plan and execute as circumstances may require.

Few teachers realize how much can be made of nature study if properly conducted, and, as Prof. Jackman's plan does not require for its execution that the teacher shall be specially trained in the sciences, it is hoped that it may be widely adopted.

CHARLES WRIGHT DODGE.
UNIVERSITY OF ROCHESTER.

Papers presented to the World's Congress on Ornithology. Edited by MRS. E. IRENE ROOD, under the direction of DR. ELLIOTT COUES. Chicago. 1896. 8vo. Pp. 208. $5.00.

The 'Congress' at which were presented the twenty-seven papers printed in this volume took place in Chicago in October, 1893. Invitations to it had been widely distributed, signed by a committee of nearly a dozen persons, of whom Dr. Coues is the only one well known as an ornithologist. In the invitation it was announced that the congress was to 'treat of birds from the standpoint of the scientist, the economist and the humanitarian,' and the scientist was warned that the audiences would be characterized by 'æsthetic feelings and humane sympathy rather than intellectual apprehension.' Under these circumstances it is not surprising that the papers show a very wide range of merit, nor that among their writers there are but few ornithologists of much prominence.

Several of the articles are deserving of cordial praise. Mr. D. P. Ingraham, for instance, gives a very interesting account of the American Flamingo, a bird that few other naturalists have seen within the limits of the United States, where to-day it is restricted to the inaccessible, shallow bays of the extreme southern coast of Florida. Another valuable contribution is that on the changes of habits of some birds in Maine, by Manly Hardy, whose many years of exceptionally careful observation have enabled him to narrate a number of instances of adaptation to changed conditions. Somewhat comparable with Mr. Hardy's notes are those of Mr. J. H. Bowles, upon instinct in birds, though of less importance, for the reason that reliable facts of this sort are far more readily attainable than such as Mr. Hardy's, which, from the nature of the case, are seldom afforded save by the life-long experience of a single observer.

The late John S. Cairns contributed a short sketch, giving a good account of the breeding haunts of the Black-throated Blue Warblers on the mountains of western North Carolina. In mentioning the fact that in the spring these birds are already engaged in nest-building at a time when northern-bound individuals of the species are still migrating through the valleys below, he incidentally referred to them as a 'local race.' This calls forth the following editorial foot-note: "As this subspecies does not appear to have been named, it may be called *Dendræca cærulescens cairnsi*.—E. C." Readers of the book may be interested to learn

that this has proved to be one of Dr. Coues's happy intuitions, and that his *nomen nudum* only awaits a description to take a secure place in ornithological nomenclature.

Dr. Emil Holub's brilliant description of a winter roosting place of *Hirundo rustica* must not pass unnoticed, nor must Mr. J. A. Allen's article on 'the migration of birds.' The latter is an exposition of the subject excellently suited to the unscientific reader, for whom, doubtless, it was intended, but it contains one or two statements that the field ornithologist of large experience might not assent to. Among the rest of the papers there are some, of which there is nothing especial to be said; others might better never have been written.

C. F. Batchelder.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, NOVEMBER–DECEMBER, 1896.

Age of the Auriferous gravels of the Sierra Nevada: By Waldemar Lindgren; with a *Report on the flora of Independence Hill:* By F. H. Knowlton. An attempt is made to definitely fix the age of the auriferous detrital rocks of the Sierra Nevada, resting uncomformably upon the bed rocks at high elevations and covered by volcanic flows. The beds include the deep gravels, the bench gravels, rhyolitic tuffs, gravels of the rhyolitic period, gravels of the inter-volcanic erosion period and andesitic tuffs and tuffaceous breccias. No fossils have been found in the deep gravels. They are older than the bench gravels, and may be as old as the Eocene. At Independence Hill leaves occur in a whitish or bluish clay interbedded with the uppermost gravels of the antevolcanic period. These plant forms point very clearly to the Miocene age of the deposit. The Ione formation, correlated with the bench gravels, is also shown to be Miocene by the presence of characteristic shells. These gravels are probably Upper Miocene. The gravels of the intervolcanic period and the andesitic tuffs are probably Lower Pliocene or Upper Miocene. In early Cretaceous the Mariposa and earlier beds were folded and eruptions were continued from the Jurassic. Shortly before the Chico the Sierra Nevada became separated from the Great Basin. In Chico time the sea advanced eastward. In late Chico and Tejon time the Sierra Nevada was being eroded, the greater part of the Chico sandstone being cut away. In early Miocene the sea retreated westward. The Sierra assumed the topography since preserved. The relation of the two eroded surfaces, Cretaceous and Miocene, is clearly discernible from the lower foot hills. In late Miocene (Ione) the sea moved eastward and gravels were formed. The gravel period was closed by rhyolitic and andesitic eruptions with Pliocene elevation. The andesitic flows are supposed to mark the close of the Pliocene. The Pleistocene was a period of erosion, with minor basaltic eruptions in the earlier and middle portions, and glaciation later.

Anorthosites of the Rainy Lake Region: By A. P. Coleman. Lawson has described eruptive masses through the Keewatin of the Rainy Lake region. The basic eruptions were identified as anorthosites, the larger area enclosing the southern arm of Bad Vermilion Lake. The rock presents some differences from typical anorthosites, an analysis showing that it is one of the most basic rocks. Lawson thought the area represented the truncated base of a Keewatin volcano. In this he was probably not correct, as apparently a long interval separated the anorthosite eruption from that of the granite.

Mechanic of Glaciers I: By Harry Fielding Reid. The greatest flow occurs through a section at the névé line, and diminishes as we go up or down the glacier from here; the diminution increasing with the distance from the névé line. In glaciers with beds of uniform slope the velocity and flow increase and decrease together, though not in the same proportion. In a glacier of indefinite length and uniform section the direction of the flow would be parallel to the slope, and the velocity parallel with the axis would not vary along the direction of flow. The velocity of a point under such circumstances would be the normal velocity corresponding to that form and size of cross-section. A glacier of uniform section could not exist if there was any melting; the slope of the glacier being uniform, wherever there is melting, the

cross-section must change to produce a smaller flow as we descend the glacier. The ice near the lower end of the glacier is under greater pressure than the normal pressure and would therefore have a tendency to rise. Stratification is not easy to recognize, but certain observations support the view that this potential rising becomes actual, which accounts for many of the phenomena observed. The surface at any point depends on velocity and rate of melting, and varies inversely with them. The larger the glacier the greater will be the differential motion. For small glaciers the differential motion is small and the slope steep. If anything cause an abnormal melting of the lower layers the upper ones will advance but over them, which is thought to be the explanation of certain facts observed in Greenland by Chamberlin and Salisbury. Although the sloping surface of Alpine glaciers is a surface of equilibrium it is unstable. If the surface be in equilibrium it will respond quickly to climatic variation. If it be widely removed from equilibrium it will respond more slowly, an explanation of the variation of glaciers differing from both that of Forel and Richter.

Loess in the Wisconsin Drift Formation: By R. D. SALISBURY. Loess has long been known to cover the glacier drift of the earlier epochs at various points. At least two loess sheets are known, one of which is correlated with Iowan ice and passes beneath the Wisconsin. Heretofore loess has not been known to occur in or above the Wisconsin drift, but during the past summer it has been found in connection with this formation at several points in Wisconsin, namely, Green Lake, Devil's Lake and Ablemans.

Geology of Chiapas, Tabasco and the Peninsula of Yucatan: By CARLOS SAPPER, translated by C. JOAQUINA MAURY and G. D. HARRIS. Southeastern Mexico shows three series of formations: an ancient complex of Palæozoic beds and eruptives in southern Chiapas; a more modern belt of Mesozoic and Tertiary formations in the middle and northern regions; and a third zone of great plains at the foot of the other belts, only slightly elevated above sea level, and of Quarternary age. In the peninsula of Yucatan there is less diversity and the beds are undisturbed, in which regard they are contrasted with those of Chiapas. Descriptions of the various formations, with lists of fossils, are appended.

Studies for Students—Stratified Drift: By R. D. SALISBURY. Water must have been an important factor in the deposition of the drift, particularly along the margin of the ice. A much larger amount of drift is stratified than is commonly thought. These deposits include extraglacial, supermorainic, submorainic and intermorainic stratified drift. The deposits made during the advance, maximum extension and retreat of an ice sheet show certain differences. During maximum extension there was a chance for the development of the following forms: (1) kames and kame belts at the edge of the ice; (2) fluvial plains and valley trains in virtual contact with the ice at their heads; (3) border plains or overwash plains in virtual contact with the ice at their upper edges; (4) ill-defined patches of stratified drift, coarse or fine, near the ice; (5) subaqueous overwash plains or deltas formed either in the sea or lakes at or near the edge of the ice; (6) lacustrine and marine deposits of other sorts, the material being furnished by waters arising from the ice. The same deposits might be formed during the advance of the ice, but would be subject to destruction by the overriding of the latter. They might be formed during the retreat, but in the latter case the formations dependent upon ice edge would not be so sharply formed. Superglacial streams are believed to be of only slight importance in this connection, because of their high velocity and the small amount of material upon the surface of the ice. Subglacial streams are considered to be the most probable means of the formation of eskers. H. F. B.

TERRESTRIAL MAGNETISM, OCTOBER.

IN the first article, by Lieutenant-General de Tillo, entitled *Isanomales et Variations Séculaires des Composantes Y et X de la Force Magnétique Horizontale pour l'Époque 1857*, the author concludes his series of charts of 'isanomolous lines' and of 'lines of equal annual secular variation.' As the title implies, the accompanying four colored plates apply to the westerly component (Y) and the northerly com-

ponent (X) of the earth's magnetic force, and to their secular variations, $\triangle Y$ and $\triangle X$. After obtaining the mean value of Y, for example, for a given parallel of latitude, he subtracts this from the values at selected points on that parallel. After proceeding thus for various latitudes he joins the places by lines where the residual Y has the same value, these lines being his 'isanomolous lines.' He finds that the X isanomolous lines present the same general characteristics as those of H (horizontal component), the Y as those of D (declination), and the Z (vertical force) as those of I (inclination). The same applies with regard to the secular variation of the components and elements. There is, furthermore, a strong resemblance between the respective isanomolous lines and lines of equal secular variation.

On the Distribution and the Secular Variation of Terrestrial Magnetism. No. IV.: On the Component Fields of the Earth's Magnetism. By L. A. Bauer. This paper is a continuation of the author's researches to localize the centers of disturbance in the earth's permanent magnetic field. He resolves the total field into three components, as follows:

I. A homogeneous magnetization about the rotation axis.

II. A homogeneous magnetization about an equatorial diameter.

III. The residual magnetization, *i. e.*, that which remains after deducting I. and II.

A striking graphical representation of No. III. is given. It is found, among other things, that the residual field and Schuster's diurnal variation field exhibit a strong resemblance.

Dr. Börgen, of Wilhelmshaven, contributes a valuable article in which he develops the most general expression for the coefficients in the formula giving the angular deflection of a magnetic needle produced by a deflecting magnet arbitrarily placed. After discussing the general case he takes up special cases ordinarily met with in practice.

Mr. Baracchi, the director of the Melbourne Observatory, gives an interesting account of 'Magnetic Work in Australia.' It seems unfortunate that no means have been found thus far to reduce and discuss the observations extending over thirty years.

Next follow editorial notes, reviews by Schott, Littlehales, Solander and P. W., and a list of current publications. This number concludes volume I.

SOCIETIES AND ACADEMIES.

THE SCIENTIFIC ASSOCIATION OF THE JOHNS HOPKINS UNIVERSITY.

THE one hundred and twenty-ninth regular meeting, President Remsen in the chair. The following papers were presented and read:

'Recent Researches on Metallic Carbides and Allied Compounds,' by Edward Renouf.

The recent application of the electric arc as a means of obtaining very high temperatures has stimulated research on metallic compounds formed at high heat and unstable in contact with water, hence not found in nature. We owe knowledge of the carbides or compounds of metals with carbon, principally to Moissan. Most metallic carbides are made by heating oxides with carbon at temperatures varying from 3500° to 5000°. They are metallic substitution products of hydrocarbons, and as a rule yield hydrocarbon and metallic hydroxide in contact with water. Some are acetylides yielding pure acetylene, as is the well-known calcium carbide used for the technical preparation of acetylene. Aluminium and beryllium carbides are methides yielding pure methane. Many other carbides, notably those of uranium and iron yield complex mixtures of saturated and unsaturated, gaseous liquid and solid hydrocarbons. Moissan thinks that natural gas and petroleum are formed by action of water on carbides contained in the earth's crust. Considering the evidence, this is the most acceptable solution of the problem of the formation of petroleum and natural gas yet offered. Metallic nitrides, compounds of metals with nitrogen, are mostly made by contact of nitrogen with metals at high temperatures; some by the action of ammonia on metals at high temperatures, when hydrogen escapes and the metallic nitrides are formed. They are decomposed by water into ammonia and metallic hydroxides, hence must be regarded as substituted ammonias.

Metallic silicides, compounds of metals with silicon, are formed by heating metals with sili-

con, and yield, on treatment with water, metallic hydroxides and silicon hydride. Metallic borides are made in the same way and behave similarly with water, excepting that boron hydride is itself decomposed by water forming boric acid.

The metallic hydrides, or compounds of metals with hydrogen, are but little known. The hydride of lithium has been carefully studied by Guntz, the hydrides of calcium, strontium and barium and of some rarer metals by Winkler. The hydrides are all stable at very high temperatures, but are decomposed violently by water, yielding metallic hydroxides and hydrogen.

Spectrum analysis proves the existence of hydrogen, carbon, and many metals, in the stars and in the atmosphere of the sun, at temperatures too high for water, ammonia and most metal oxides to exist. It is highly probable that the metals exist in the heavenly bodies at the present time and formerly existed on the earth when the earth was hot enough, in combination with the elements mentioned above. A study of the decomposition of these compounds with water and with air, throws light on the chemical changes and rearrangements occurring on the cooling of a world; for example, metallic hydrides cooled to a sufficient temperature in presence of oxygen take fire and burn, forming metallic oxides and water vapor; the oxides form hydroxides with the water. Carbides are broken down by the water into hydroxides and hydrocarbons. The hydrocarbons burn in oxygen to form water and carbonic acid, which last combines with the hydroxides to form water and metallic carbonates. The ammonia necessary for the beginnings of plant life could be furnished by action of water on the nitrides. The formation of silicates and borates would necessarily occur in the same way as that of the carbonates. Thus we can by laboratory study form a clear picture of the genesis of the metallic compounds now existing on the earth.

'A Recently Discovered Property of the Blood Serum in Animals immune from Certain Diseases and its Application to the Diagnosis of these Diseases in Human Beings,' by Dr. Simon Flexner.

A significant advance has just been made in regard to the diagnosis of typhoid fever. The basis of this advance is the so-called cholera reaction of Pfeiffer which, it may be recalled, was introduced for the purpose of discriminating between the vibrio of Asiatic cholera and certain allied bacterial forms. Pfeiffer found that the blood serum of an animal rendered immune from the cholera germ would, if admixed with a pure culture of this germ and introduced into the peritoneal cavity of a guinea pig, cause a rapid dissolution of the micro-organisms, while no effect was exerted upon other, although closely allied, species. The same reaction can be obtained with various other bacterial forms, such as the diphtheria bacillus, typhoid bacillus, cholera bacillus, etc., provided the serum of animals immune from these organisms be substituted for the cholera serum. Thus it was shown that the action of the immunized sera is specific for a particular kind of bacterial protoplasm. The changes which are induced in animals by exposing them to experimental infection with the bacteria mentioned take place, in a similar manner, in human beings who suffer from the diseases caused by these micro-organisms. In the course of typhoid fever, cholera and diphtheria immunizing substances, before absent, now appear in the blood and other fluids of the body.

It seems very natural to reverse the order of applying the reaction mentioned and, instead of using a specific immunized blood serum to detect a particular kind of bacterium, to employ a specific micro-organism in order to discover the presence of the immunizing substances. Proceeding upon this idea Widal, and after him Grünbaum, suggested that in doubtful cases of typhoid fever the blood of the patient might be utilized for the purposes of diagnosis. The method of making the tests are simple and readily carried out. Widal recommends adding to a bouillon culture of the bacillus typhosus about 1-10th of its volume of the blood serum from the suspicious case. If it is one of typhoid fever the bacteria soon begin to run together, form clumps and gradually sink to the bottom of the test tube in the form of a sediment. A slight modification of this method consists in using a mixture of blood serum and bouillon in the proportions mentioned, which

is inoculated with typhoid bacilli from a pure culture. The growth of the bacilli, instead of taking place in a diffuse manner throughout the fluid, is in the form of clumps, which fall to the bottom of the tube. In the simplest form the reaction may be obtained from a drop of blood taken from the finger tip or lobule of the ear and which has been allowed to dry upon a glass slide. The dried blood is moistened with a drop or two of water in order to cause a solution of the serum, and a small amount of this solution is added to a drop of a living culture of the typhoid bacillus. If this mixture is now observed under the microscope the bacilli are seen to quickly lose their motility, and in a short while (within 30 minutes) to run together to form clumps, or, as these have been called, 'agglutinates.' This reaction has been obtained as early as the third or fourth day of the disease and as late as the ninetieth, and promises to be fairly constant. It may persist for a considerable period—limit unknown—after recovery; for the blood of persons still shows the reaction two years after the disease. As far as we are informed at present the reaction is to be relied upon as diagnostic. It has grown out of the Pfeiffer cholera reaction; but it differs from this in dispensing with an animal for the experiment, and also because in it the bacteria do do not proceed to disintegration but merely to agglutination.

The papers presented and read by title were:

'On Singularities of Single Valued and Generally Analytic Functions,' by A. S. Chessin.

'On the Analytic Theory of Circular Functions,' by A. S. Chessin.

Adjourned. CHAS. LANE POOR,
Secretary.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 256th regular meeting of the Society was held Tuesday evening, January 5, 1897. The program for the evening consisted of a Review of Anthropological Progress during 1896, in ten minute papers.

Dr. Thomas Wilson, in his review of Prehistoric Anthropology during the year 1896, considered: 1. *Pithecanthropus erectus*, in which he noted the decision of this Society, that the specimens found by Dr. DuBois in the Island of Java were human remains, and that naturalists concurred in this view; that they belonged to the Pliocene age, and the associated fossil vertebrate fauna resembles that of the Siwalik hills of India. Personally he (Dr. Wilson) refused his adhesion to this theory and proposed to await further developments. 2. Prehistoric Man in Egypt. Late explorations and excavations made in Chaldea, by a party from the University of Pennsylvania, pointed to the discovery of written characters, said to date about 5000 B. C., that of Egypt about 1000 years less. He had seen the last will or testament of an Egyptian, from Kahûn, dated about 2650 B.C. and has a copy of its translation, which could be admitted to probate in our Orphans' Court.

The discoveries by General Pitt-rivers and Prof. H. W. Haynes did much toward establishing the existence of a Palæolithic age in that country. The latest researches were made by Mr. de Morgan, and prehistoric settlements were found scattered from Cairo to Thebes, a distance of nearly 500 miles, and a collection from these places was exhibited by Dr. Wilson, which indicated human occupancy of the Nile valley by a people in the Neolithic stage of culture and, consequently, much earlier than any of those belonging to any Egyptian stage heretofore known.

Prof. Otis T. Mason then spoke 'On the Mato Grosso, South America, as a Mingling Ground of Stocks,' and called attention to the investigations of Paul Ehrenreich, Carl von den Steinen and Herman Meyer. In the region of the Xingu, Tocantins and Maderia rivers are mingled people speaking the same stock languages, Carib, Arawak, Gès or Tapuya, as when Columbus made his first voyage of discovery, and using implements found among the inhabitants of the head waters of the Amazon in western Brazil and eastern Peru, and also those in use in eastern Brazil; thus were the cultures of the east and west parts, both dissimilar, found associated in the Mato Grosso.

There are two kinds of bows found in South America: the long, black palm-wood bow, of rectangular shape, of the western country; and the broad, wide blade of red mimosa wood, of

eastern Brazil, and monkey bone lashed at an angle, used as harpoon and arrow combined in the west and pointed reed in the east.

In the west, wood-skin or bark boats; in the east, raft of logs or reeds; but in this region the Mato Grosso, both varieties of bows, arrows, rafts and boats were used, showing how the two dissimilar cultures were united in a common locality. Discussed by Messrs. Pierce and Lamb.

Mr. Geo. R. Stetson gave the results of 'Memory Tests of Whites and Blacks,' in which he gave the details of tests made upon white and black school children. In some tests the range of percentage varied quite largely and in others they were remarkably equal between the two classes of subjects. Discussed by Prof. Lester F. Ward.

'Aboriginal Habitations of Maine,' by Mr. F. H. Cushing, was omitted owing to his absence.

Prof. W J McGee spoke upon Zooculture, in which he described the three stages of the relation of birds and animals to man, as individuals and as a community: 1. Toleration. 2. Domestication. 3. Artificialization. Discussed by Messrs. Flint and Stetson.

Dr. J. W. Fewkes read a paper on 'Types of Pueblo Pottery.' He noted the fact that pottery was found in the most ancient ruins and that the art of pottery making was still practiced by modern Pueblo people, but it had degenerated as to texture, finish and adornment.

More care was taken by the ancient potters in the fineness of paste, in the symbolic decoration and general finish. In classifying pottery the classification of Holmes seemed the best. 1st. Coiled ware. 2d. Plain ware. 3d. Painted ware, and to this he would add a 4th, glazed ware.

The principal fact brought out in his studies for 1896 was the collection of material illustrating the extension of Tusyan people southward. The one point he wished to emphasize, relative to the different types of Pueblo pottery, was homogeneity of ancient Pueblo culture. Discussed by Prof. Thos. Wilson.

Dr. J. H. McCormick reviewed the principal events in the field of Folk-Lore for 1896. The memoirs of the American Folk-Lore Society were by Mrs. Fanny D. Bergen, on 'Current Superstitions,' in which she has collected a great variety of superstitions of English-speaking people in the United States, embracing every phrase of life, from birth to death; and 'Navajo Myths,' by Dr. Washington Matthews. No one is better qualified than this author to tell us the mythology of this tribe, and it constituted the most valuable contribution yet published concerning this interesting people.

The speaker also paid deserved tribute to the memory of Capt. J. G. Bourke, who had died during the summer of 1896, and who was at the time President of the Folk-Lore Society. These two publications, together with Mr. Cushing's paper on 'Outlines of Zuni Creation Myths,' in 13th Annual Report of Bureau of Ethnology, constituted the most important contributions to Folk-Lore during 1896. The work of the Society was discussed at some length, and the establishment of a Local Branch at Cincinnati, under the presidency of Prof. Chas. L. Edwards, of the University of Cincinnati, as a result of a visit by the speaker to that city, and the excellent work done by the Local Branch in Baltimore, were noted.

The 8th annual meeting, in New York, was then considered in some detail.

'Developments of Education during the year' was the subject of Mr. J. H. Blodgett, and it was noted that expansion and modification of ideas rather than distinct steps or discoveries had been the rule.

The most notable events were the continued agitation of the art and manual training studies in schools, child study and its bearing on psychology, and the teaching of religion in schools. The latter had been discussed more in other countries than our own. Considerable attention had been given to the methods of teaching and the principles which underlie them.

The 257th regular meeting of the Anthropological Society was held Tuesday evening, January 19, 1897.

This being the annual meeting, the reports of the Secretary, Secretary of the Board of Managers, Treasurer and Curator were submitted.

The election resulted in the selection of the following officers for 1897: President, Dr. Frank Baker; 1st Vice-President, Prof. W J McGee (re-elected); 2d Vice-President, Mr. Geo. R. Stetson (re-elected); 3d Vice-President, General Geo. M. Sternberg (re-elected); 4th Vice-President, Dr. Cyrus Adler; General Secretary, Dr. J. H. McCormick (re-elected); Secretary to Board, Mr. Weston Flint (re-elected); Treasurer, Mr. P. B. Pierce (re-elected); Curator, Mr. F. W. Hodge (re-elected); Councils (additional members of): Mr. J. H. Blodgett, Mr. J. W. Fewkes, Dr. Geo. M. Kober, Mr. J. D. McGuire, Mr. J. O. Wilson, Dr. Thomas Wilson.

No papers were read.

J. H. McCormick, M. D.,
Secretary.

Section of the American Chemical Society, 92d meeting, January 14.

At this the 13th annual meeting of the Society the following officers were elected for the ensuing year; viz:

President, W. D. Bigelow; Vice-Presidents, H. N. Stokes, Peter Fireman; Secretary, V. K. Chesnut; Treasurer, W. P. Cutter; Executive Committee, the foregoing officers and E. A. de Schweinitz, Chas. E. Monroe, W. H. Krug, Wirt Tassin.

Dr. E. A. de Schweinitz, the retiring President, announced the date of his annual address as February 25th, the subject to be 'The War with the Microbe.'

V. K. Chesnut,
Secretary.

Boston Society of Natural History.

A general meeting was held December 16, 1896, twenty-eight persons present.

Prof. F. W. Putnam prefaced his statement concerning some recent work at Trenton, N. J., bearing upon the early presence of man in the Delaware Valley, with a detailed description of the discovery, in 1879, in the undisturbed gravel, of a stone implement near a boulder. Explorations in the Trenton gravels have been carried on systematically since 1891, by Mr. Ernest Volk, under the direction of Prof. Putnam; and a section at the place recently examined shows three distinct upper layers, namely: (1) black soil, (2) glacial sand, and (3) white glacial sand. Implements of chert, jasper, and quartz, as well as of argillite and of pottery, characterize the black soil, while chipped argillite, with occasionally a quartzite, are found in the glacial sand. All but four specimens thus far found in the glacial sand are of chipped argillite; there are no jaspers or cherts. The distinctive implements and the layers are sharply correlated, and the accuracy of Abbott's early work is emphasized by the later work of Volk.

Prof. G. Frederick Wright discussed the extent of preglacial erosion in the United States and its bearing on the question of the length and date of the Glacial period. The new evidence as to the age of the deposit of the Trenton gravels confirms the results first announced by Lewis and Wright. The Philadelphia brick clays are older than the Trenton clays, and the work of E. H. Williams proves that the rock erosion was earlier than the Philadelphia brick clays. Prof. Wright reviewed the work of Salisbury in New Jersey, of White in the deposits of the Monongahela River, the evidence obtained in Iowa, and Claypole's discovery in the glacial till of Ohio, and showed that the necessary data for more accurate conclusions were accumulating.

Prof. Putnam spoke of the rude knife found at Steubenville as the most highly finished of all the specimens yet found, and said that being *chipped* was favorable to its greater antiquity than if it had been *flaked*. The patina on the implement is very decided.

Samuel Henshaw,
Secretary.

The Geological Club of the University of Minnesota.

At the weekly meeting, held Saturday, January 16th, a paper was read by Arthur H. Elftman, on the use of certain terms prominent in petrology. Incidentally the terms granitic and pegmatitic were noted. The growth of the terms ophitic and poikilitic in geologic literature was then outlined and an attempt made to define them more rigidly than had hitherto been done by petrologists.

Charles P. Berkey,
Secretary.

SCIENCE

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FRIDAY, FEBRUARY 5, 1897.

CONTENTS:

A National University.....197
Science and Pseudo-science in Medicine: GEORGE M. STERNBERG.....199
The American Psychological Association: LIVINGSTON FARRAND.....206
The American Folk-lore Society: HARLAN I. SMITH.215
Horatio Hale: D. G. BRINTON.....216
Emil du Bois-Reymond: S. F. MELTZER.....217
Current Notes on Meteorology:—
The Plague and Climatic Conditions; Chinook Winds in the Northwest: R. DEC. WARD.....219
Current Notes on Anthropology:—
Ethnologic Medicine; Sacred Secret Societies: D. G. BRINTON.....220
Notes on Inorganic Chemistry: J. L. H.....221
Astronomical Notes: H. J.....222
Scientific Notes and News.....222
University and Educational News.....225
Discussion and Correspondence:—
Nomenclature of Metamorphic Lavas: H. W. TURNER. *The Law of Size-weight Suggestion:* E. W. SCRIPTURE.....226
Scientific Literature:—
Miall's Round the Year. E. S. MORSE. *Researches on Mimicry:* VERNON L. KELLOGG.....227
Scientific Journals:—
American Journal of Science; The American Geologist.....228
Societies and Academies:—
Zoological Club of the University of Chicago: S. WATASE, KATHERINE FOOT, C. M. CHILD, A. D. MEAD, C. O. WHITMAN. *Biological Society of Washington:* F. A. LUCAS. *Entomological Society of Washington:* L. O. HOWARD. *Geological Society of Washington:* W. F. MORSELL. *New York Academy of Sciences:* J. F. KEMP. *The New York Section of the American Chemical Society:* DURAND WOODMAN. *The Academy of Science of St. Louis:* WM. TRELEASE.....230
New Books.....240

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A NATIONAL UNIVERSITY.

THE reconstruction of the University of Paris, the efforts in and out of the British Parliament to make a University of London, the great success of the University of Berlin, and the renewed advocacy of a National University at Washington, indicate a movement which, we believe, makes for the progress of education and science. There are dangers in centralization, but these are small in comparison with the promise of great centers, where specialization and coöperation can be carried forward to the degree demanded by the present state of learning and science.

It is not necessary to take up space in this JOURNAL to set forth in detail facts on which we are all agreed—that universities are necessary for the progress and even the preservation of our present civilization; that America should have universities equal to those of any other country; that the founding of new universities, such as Johns Hopkins, Chicago and Stanford has been productive of good; that the establishment by gifts or bequests of a university at Washington greater than any other would be received with universal satisfaction. It is, however, desirable to consider the objec-

tions that have been urged against the establishment, by the government, of a national university at Washington. These may be reduced to three: the cost of maintenance, the risk of political intermeddling and the alleged interference with existing institutions.

A national university should be supported by liberal appropriations, but the cost is not as great as is sometimes supposed. The annual salaries paid at Berlin amount to less than $200,000. The United States spends about $175,000,000 annually on its common schools. No one grudges this large sum, and yet it is spent chiefly for the benefit of the individual, whereas the higher education is chiefly for the benefit of the state. All the money spent on universities since the first beginnings at Paris and Salerno has been paid back by the results of the education of one man such as Faraday or Pasteur. Higher education in America has been liberally endowed by rich men, but if it is desirable to have these endowments it seems needless to be dependent on individual initiative. Whether the money come from endowments or from taxation it must be taken from the wealth of the country. It may represent a part of the extra price paid for each gallon of kerosene oil, or it might result from a tax paid on the $10,000,000 worth of precious stones annually imported and used chiefly for purposes of ostentation. We might as well wait for rich men to give our government ships of war as to be dependent on them for our educational institutions. A university supported directly by the people would have peculiar influence and special dignity.

There is, perhaps, a more serious question as to whether the representatives of the people at Washington are competent to manage a university. Might they not regard it as part of the spoils of victory? We think the risk is slight and transient. The Smithsonian Institution and the Military Academy at West Point have not become involved in practical politics, and the State universities have in nearly all cases not only remained non-partisan, but have set a salutary example to other departments. A national university should not offer patronage and high salaries, but permanency of office, the most perfect facilities for research and publication, the ablest students to teach and the best intellectual environment. It would by its own nature be self-conservative. A national university would not only be, in all probability, itself free from political influences, but would tend to preserve the scientific bureaus from these and to purify and elevate all offices under the government.

It may be said that our existing universities supply the need and that a new university would interfere with these. This was not the opinion of the heads of Cornell, Pennsylvania and Stanford Universities, who have been among the ablest and wisest advocates of a national university. The growth of the University of Berlin has not weakened the other German universities. A great national university would be the head of our educational system. It would not interfere with existing universities any more than these interfere with our colleges or our colleges with our schools. Our present universities consist chiefly of professional schools, on the one hand, and of col-

leges for the instruction of boys, on the other. They are, indeed, developing toward true universities, but nothing could better hasten and direct this development than a national university.

From a theoretical point of view it would seem that all the arguments which have been urged against the establishment of a national university turn out to be in its favor. The cost, the incompetence of government and the claim that existing universities suffice are, however, practical difficulties which we do not underestimate. Indeed, these are so evident that we should regard it as useless to advocate the immediate establishment of a great national university. We rather hope for a gradual growth from the national institutions already existing at Washington.

We have there great libraries, museums and laboratories, able investigators engaged in advancing pure and applied science, and younger men learning from them the methods of research. These are the essentials of a university. No university in the world includes so many or such able investigators, teachers and students of geology as the U. S. Geological Survey, and in many departments the work at Washington surpasses any American university in the amount of investigation accomplished and in the number of investigators trained.

We should recommend the development of the Bureau of Education somewhat in the direction of the University of the State of New York. Let it have power to regulate academic degrees and to confer them. Degrees may belong to an immature civilization, but this is just the kind of civilization of which we must make the best. Workers in the different government divisions and others having the proper preliminary education could, on presenting a thesis showing original work and passing an examination, receive the doctorate of philosophy, and this would qualify them as a civil service examination for promotion. The present Commissioner of Education, and perhaps the regents of the Smithsonian Institution, could govern the university. Examiners could be appointed from leading representatives of science and learning who would meet yearly for a week of convocation in Washington. We believe that, without radical changes and with nominal expense, there could be established at Washington a national university likely to become the world's greatest university.

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*SCIENCE AND PSEUDO-SCIENCE IN MEDICINE.**

ONE of the definitions given by Webster for the term 'science' is: "Truth ascertained; that which is known. Hence, specifically, knowledge duly arranged, and referred to general truths and principles upon which it is founded and from which it is derived; a branch of learning considered as having a certain completeness." Having this definition in view I think we are justified in speaking of medicine as a science. No doubt it is incomplete in many directions, but by the application of scientific methods of research such rapid progress has been made during the past fifty years that to-day medicine stands upon a substantial basis of 'truth ascertained' in all of its departments, and when we consider the breadth of the field covered by these various departments the lacunæ, in our knowledge, are no greater than in many other

*Read before the Anthropological Society of Washington, December 15, 1896.

branches of science, *e. g.*, in physics or in geology.

Evidently scientific medicine must be founded upon an exact knowledge of the structure (anatomy) and functions (physiology) of the human body in a healthy condition and of the changes in structure and function (pathology) which result from various disease processes; of the causes (etiology) natural history (clinical medicine) and regional distribution (medical geography) of the diseases which afflict mankind and the lower animals (comparative pathology); of the toxic action of various substances from the animal and vegetable kingdom (toxicology) and of the use of these and of other nontoxic substances, physical agents, etc., in the treatment of disease (therapeutics). For the illiterate and even for many of the so-called educated class the whole of medicine consists in the cure of disease by medicines, or by some agency, natural or supernatural, and a failure to cure is evidence that medicine is not a science. We readily admit that the cure of disease is one of the principal objects which medical science has in view and that from a scientific standpoint therapeutics is very much behind some of the other branches of medicine. This is shown by the diversity of remedies prescribed for certain diseases and the failure of any one of these remedies to effect a cure in many cases. But, on the other hand, therapeutics has made great advances during recent years and by the application of scientific methods of research the exact value of alleged remedies and of various methods of treatment is now determined with far greater precision than formerly.

A few years ago the intelligent and honest physician did not claim to have any considerable number of specific remedies at his command; but his scientific knowledge relating to the cause, symptoms and pathology of disease enabled him to conduct many cases to a successful termination which without his assistance would have proved fatal. By the use of scientific instruments and methods of investigation he was able to make an early diagnosis and to give advice which might stay the progress of a disease which in its more advanced stages it would have been beyond his skill to arrest. Recently several additions have been made to the list of specific therapeutic agents and there is good reason to believe that further discoveries in this direction will be made as a result of investigations now being conducted in pathological laboratories in various parts of the world. Among the most important recent discoveries in this department of scientific medicine we may mention the use of thyroid extract for the cure of myxœdema, the antitoxin of diphtheria and the antitoxin of tetanus. The wonderful triumphs of modern surgery, the scientific precision of the methods employed by the skilled ophthalmologist and the achievements of the scientific obstetrician can only be referred to *en passant* in support of the statement that we are to-day justified in speaking of medicine as a science.

While, as we have said, the cure of disease is one of the principal objects which medical science has in view, this is by no means the sole object. Sanitary science is a branch of medicine based upon chemical and physiological knowledge which has been gained by the painstaking researches of a host of investigators who have determined the constituent elements of the air we breathe, the water we drink, the food we eat, and the nature of the harmful impurities which are found in these; it teaches us the difference between healthful indulgence in food, exercise, mental activity, etc., and those excesses which lower the vital resisting power and establish a predisposition to disease. Preventive medicine, which is a broader term, if we regard the beneficent

results accomplished, must be placed in advance of therapeutics. Where thousands have been saved by the timely administration of suitable medicines, or by the skillfully performed operation of the surgeon, tens of thousands have been saved by preventive medicine. And preventive medicine is to-day established upon a strictly scientific foundation. If our practice was *pari passu* with our knowledge infectious diseases should be almost unknown in civilized countries and those degenerative changes of vital organs which result from excesses of various kinds would cease to play a leading part in our mortuary statistics. But while our knowledge is still incomplete in some directions, and while individuals and communities constantly fail to act in accordance with the well-established laws of health and the scientific data which furnish the basis of preventive medicine, the saving of life directly traceable to this knowledge is enormous.

Small-pox no longer claims its victims in any considerable numbers except in communities where vaccination is neglected; the last extended yellow fever epidemic in the United States occurred nearly twenty years ago; cholera has been excluded from our country during the last two widespread epidemics in Europe and its ravages have been greatly restricted in all civilized countries into which it has been introduced; the deadly plague of the 17th and 18th centuries is no longer known in Europe, and the prevalence of typhus (so-called 'spotted' or 'ship fever') has been greately limited. Typhoid fever, tuberculosis and diphtheria are still with us and claim numerous victims, but we know the specific cause of each of these diseases; we know where to find the bacteria which cause them and the channels by which they gain access to the human body; we know how to destroy them by the use of disinfecting agents ('antiseptics'); and in the case of diphtheria we have recently discovered a specific mode of treatment which when promptly applied reduces the mortality from this dread disease to a comparatively small figure.

The brilliant success which has attended the carrying out of modern antiseptic and aseptic methods in surgical and obstetrical practice are too well known to call for extended remark.

Sir Edwin Arnold in an address delivered in 1895 at St. Thomas' Hospital, upon 'Medicine, its past and future,' says:

"One of the high authorities already quoted has furnished a calculation of the salvage of life effected even during the early years of the present reign by the commencing improvements in preventive and curative medicine. In the five years from 1838 to 1842, London with an average population of 1,840,865 persons, had an average annual mortality of 2,557 in every 100,000. In the five years from 1880 to 1884 the average metropolitan population was 3,894,261, and the average annual death-rate 2,101 in each 100,000. A calculation will show that these figures represent a saving or prolonging of lives during that lustrum to the number of 96,640. The mean annual death-rate has now been reduced to a point lower than shown in these figures. It was 22.16 per 1,000 for England and Wales at the commencement of the reign, and it is to-day better than 19.0 per 1,000, while in Her Majesty's army and navy the diminution of mortality apart from deaths from warfare has proved even more remarkable, and in India, where we used to lose 69 per 1,000 yearly, this has been reduced to 16 per 1,000."

Having thus briefly referred to the present status of scientific medicine I shall devote the remainder of my time to a consideration of the second theme included in the title of this paper, viz.: Pseudo-science in medicine.

History shows us that the development of each branch of science has been accompanied by unfounded inferences, based upon partial knowledge, which have been abandoned by the learned as the science has become established upon a basis of ascertained facts, but which have continued to pass current among the ignorant, often

for centuries after they have been abandoned by the well-informed. Thus, astrology, alchemy, phrenology, homeopathy and 'Christian Science' have met with acceptance not only by the ignorant, but by many of the so-called educated class. As a matter of fact, a scholastic and classical education does not greatly aid in the differentiation between science and pseudo-science; and at the present day many persons who belong to the 'educated class' and even to the learned professions are led astray by claims made upon what appears to them to be a scientific basis. Unless the spirit of scientific scepticism, which demands absolute demonstration before final acceptance, has been cultivated by special training, there is always a liability to be misled by the specious claims of pseudo-scientific pretenders, or of the still more dangerous charlatans who believe in themselves and their pseudo-discoveries. And even among those who have had a more or less complete scientific training it often happens that there is a natural tendency to generalize from insufficient data and to jump at conclusions in advance of the experimental evidence which alone could justify them. Such men are even more dangerous in the ranks of scientific workers than they would be as theorists who ignored the value of scientific research; and many pseudo-scientific discoveries which have passed current for a time, and the refutation of which has been held to show the uncertainty of scientific deductions, have been made by men of this class, whose mental characteristics entirely unfit them for scientific research.

Hand in hand with the progress of medical science we see an army of pseudo-scientific quacks who trade upon the imperfect knowledge of the masses, and by plausibly written advertisements convince many, even of the educated classes, that their particular method of treatment is based upon the latest scientific discoveries. A Priestley discovers oxygen; the physiologists show that this gas is essential to life and that the maintenance of a full degree of vital activity depends upon the possession of healthy lungs of ample capacity and the respiration of pure air; the scientific physician discovers defects in the respiratory apparatus and under certain circumstances prescribes oxygen for the relief of symptoms resulting from a deficient supply of this life-sustaining gas. But the pseudo-scientist extols oxygen as a cure-all for pulmonary complaints, or invents an apparatus which may be held in the hand or carried in the pocket, by which oxygen will be absorbed in some mysterious way, and without difficulty obtains numerous certificates as to the marvelous cures effected by his method. A Franklin draws lightning from the clouds; a Galvani shows that an electric current may be developed by the contact of metals and that such a current causes muscular contraction; and innumerable patient investigators add to our knowledge of electricity. The scientific physician avails himself of this potent agent for the treatment of certain ailments in which it appears to be indicated, but admits that he meets with many disappointments in his clinical experiments. The pseudo-scientific quack writes, or has written, advertisements in which fact and fiction are so commingled that even educated persons may be deceived, and having aroused interest in the alleged therapeutic value of this mysterious agent, offers his electric belt, or finger ring made of two metals, or pocket battery, as a sure cure for certain specified ailments, or, if less modest and more certain of the credulity of the public, as a cure for all of the diseases to which man is subject.

Again, a Pasteur proves that the disease of sheep and cattle known as anthrax is due to a microscopic organism found in

the blood; an Obermeyer discovers a different microorganism in the blood of relapsing fever patients, and numerous patient workers in laboratories rapidly add to our knowledge of pathogenic bacteria. Then comes the man with the microbe killer. He tells you that all diseases are due to germs in the blood and that his fluid kills them without fail. Science has demonstrated that comparatively few of the infectious diseases of man are due to the presence of pathogenic bacteria in the blood, and that the microbe killer has comparatively little germicidal value; but a credulous public accepts the interested statements which appear to have a scientific basis, and swallows the microbe killer with impunity, if not with benefit. And so it goes. Science establishes the value of thyroid extract for the cure of myxedema, and immediately the public are called upon to swallow extracts of brain for cerebral trouble, of heart for cardiac disease, etc. Even the Chinese pulse-doctors obtain a large clientele on the Pacific coast. Their solemn looks and pretentious claims impose upon the ignorant, and it is said that educated people not infrequently consult them.

One of the most successful pseudo-scientific quacks of the present day has written a book in which he gives a history of the alleged discovery of his cure-all and from which I desire to make two or three quotations. One of these shows the author to have been a close observer of the genus homo. He says:

"People should not be led away by every charlatan who jumps up before them and talks; but as long as the world lasts there will probably be fools in it, and fools are a godsend to rogues. There is a fascination in being humbugged. Make it known to the world that you are going to do some impossible thing, and the world will pay money to come in and see you do it, although well understanding all the while that the thing cannot be done."

The financial success of 'the microbe killer' indicates that the discoverer of this alleged cure-all has substantial proof of the truth of the frank statements above quoted. The author's personal experience with microbes is given on another page as follows:

"When I drove to my seed store I knew that I could sit only on the edge of my buggy, because the microbes would not let me sit in any other way, and when I stepped to the ground I knew that it took me several minutes before I could move, the microbes that produced sciatica and rheumatism objecting to being disturbed, and so preventing me. Every attempt to move had to be slow and deliberate, until they should get accustomed to the change. I was a living barometer. Whenever the weather altered, and especially if it became cooler, my collection of microbes could anticipate it two or three days, and when the storm came they would freeze and force me to take refuge by a red-hot stove to get them quieted."

On another page the author states his theory with reference to disease and its treatment as follows: "But I knew that his symptoms were of secondary importance. They were interesting to have, but not essential, because all disease is due to the same cause and requires but one cure." Of course that one cure is the microbe killer and you must beware of imitations. The author describes his unsuccessful attempt to obtain relief from the advertising quacks, as follows:

"Good friends were generous with their advice. I was told to try first one thing then another, but I had become wearied with what I had come to believe was so much humbug, and I determined to swallow no more medicine. I again studied advertisements. There I saw commended electric belts, porous plasters, liniments, lotions and salves, and all sorts of external applications that would cure everything, purify the blood, strengthen the nerves, stimulate the functions of the organs, kill the microbes, and rejuvenate the individual in mind and body. Well, this was something. Whatever such things would or would not do, there was no medicine in them—nothing to swallow, no poison, so, if they did no good, I could not see that they would do harm. The end of my thinking was that I sent off ten dollars to Chicago for an electric belt. Some of the advertising firms fail to respond, as they promise, to money remittances, but my belt came, and I lost no time in fixing it on. It reminded me of former days when I was a soldier, with belt and sabre, in the German

army. Then I jumped ditches eight feet wide, and sang and laughed when others fell into the water, but now things were changed. Then I had health and youth, now I was far older in health than in years, but I concluded that, being but forty-three, if the belt did all that was promised for it, there should be no reason why I might not live forty years or more yet. So I gave the belt a good chance. I wore it faithfully for three months, and tried to help it by covering myself in every likely spot with porous plasters. In that condition I went about my business, clad in a kind of coat armor to fight microbes. I tried to persuade myself that I was doing exactly the right thing, and set to work to find enjoyment among my roses and to forget my troubles.

"But it was of no use. My limbs did not consider that much enjoyment. The microbes were unhappy, and would not be appeased. They gave me no rest; they tortured me unceasingly, and finally they drove me back in despair and desperation to my bed."

These unhappy microbes were finally appeased or destroyed by the 'microbe killer,' and having generously determined to allow his fellow-men to share in the benefits of his wonderful discovery the Texas seedsman soon became rich and famous. His book is illustrated by photomicrographs which are supposed to show the microbes of various diseases. The writer is unable to recognize any known disease germ in these photomicrographs, some of which show, more or less distinctly, epithelial cells, granular débris of the various tissues, yeast cells, pencillium spores, etc.

Another pseudo-scientific 'discovery' which is largely advertised in the monthly journals is the 'Electropoise,' which is described as 'a little instrument which enables the system to take on oxygen freely from the atmosphere. This addition of nature's own tonic increases vitality, tones up the nervous system, purifies the blood, and by expelling the morbid matter and diseased tissues restores the body to its normal condition—health.' The *modus operandi* of this wonderful instrument is more fully explained in the following published certificate (advertisement in *McClure's Magazine*):

"We are slow to commend new discoveries of any kind, for the reason that so many of them prove to be worthless. But we commend the 'Electropoise' as a safe and effective health restorer. We do not pretend to explain the philosophy of its workings, but having realized its beneficial effects we can speak of its results. One might conclude, from its name, that it was an electric battery. But it does not generate electricity and is in no sense a battery, belt, sole, or anything kindred to them. It consists of a small cylinder called a 'polarizer,' which is used in connection with the patient's body by means of a common electric cord. This polarizer causes oxygen from the atmosphere to be absorbed by the entire surface of the body with great rapidity, the strength of the absorption being regulated according to the ability of the patient to receive.

* * * * * * * *

"After a year's use we have this to say in its favor: (1) We have taken no medicine for the year. (2) All traces of la grippe and an old sunstroke trouble have disappeared and no symptoms of either remain. Once or twice, from severe overwork, we have found it necessary to hold up for a few days, but in no time for fifteen years have we been better than during the past year. Much of this we attribute to the use of the 'Electropoise.'

"This notice of the 'Electropoise' is without solicitation and entirely gratuitous. We do it for the good of the afflicted. We have no personal interest in it and are not paid for what we say in its favor. Persons desiring further information can address the agent."—Rev. Wm. McDonald in *Boston Christian Witness*.

We would suggest to the Rev. Wm. McDonald that he try the following simple experiment: Having connected the 'polarizer' with his leg by means of the 'common electric cord,' let him place his one hand over his mouth and nose, thus shutting off oxygen of the atmosphere from the lungs, which have been provided by nature to furnish the necessary supply of this gas. Now let him note by a watch how long the supply of oxygen 'absorbed from the entire surface of the body' will answer as a substitute for nature's method of supplying this gas. We venture also to suggest to the Rev. Wm. McDonald that 'all traces of *la grippe* and of an old sunstroke trouble' might have disappeared during

the year if he had not used the Electropoise. Assuming that this certificate is genuine, it answers very well to illustrate the fact that educated men, who have not been trained in the methods of scientific investigation, often arrive at conclusions entirely unjustified by the evidence before them by the dangerous use of the *post hoc ergo propter hoc* method of argument.

The fact that a considerable proportion of those who are sick from various acute or chronic ailments recover after a time, independently of the use of medicinal agents or methods of treatment, taken in connection with this tendency to ascribe recovery to the treatment employed, makes it an easy matter to obtain certificates of cure for any nostrum which an unprincipled money-seeker may see fit to offer to a credulous public. If ten in a thousand of those who have used the alleged remedy believe themselves to have been benefited, their certificates will answer all purposes of exploitation and the 990 will not be heard from by the general public.

As was to have been expected, the X-ray has already been made a source of revenue by more than one pseudo-scientist. The following account of the *modus operandi* of its supposed therapeutic action has recently been published in the newspapers:

"After the Crookes tube is excited by the coil the magnetic lines of force are projected down in the same manner as they pass off from a magnet, and traversing the intervening space, pass through the body down to the floor, and back to the coil and tube again, completing the circuit.

"The X-ray is electrostatic in character and of a very high potential. With every discharge from the Crookes tube oxygen is liberated in the body, as well as the surrounding atmosphere, which, combining with nascent oxygen, forms ozone.

"It is due to the electrolysis produced in the body that we are able to destroy the bacilli in contagious disease, ozone being the most powerful germicide known."

We remark, first, that we do not fully understand why 'the magnetic lines of force' are reflected back by the floor, 'completing the circuit.' Inasmuch as the X-rays pass through wood, this mysterious action of the floor appears to call for some further explanation.

We will pass by the ingenious explanation of the formation of ozone, as a result of the action of the X-ray, to call attention to the mistaken statement that ozone is 'the most powerful germicide known.'

Upon this point I take the liberty of quoting from the Manual of Bacteriology:

"The experiments of Fränkel show that the aerobic bacteria grow abundantly in the presence of pure oxygen, and some species even more so than in ordinary air.

"*Ozone*—It was formerly supposed that ozone would prove to be a most valuable agent for disinfecting purposes, but recent experiments show that it is not so active a germicide as was anticipated, and that from a practical point of view it has comparatively little value.

"Lukaschewitsch found that one gramme in the space of a cubic metre failed to kill anthrax spores in twenty-four hours. The cholera spirillum in a moist state was killed in this time by the same amount, but fifteen hours' exposure failed to destroy it. Ozone for these experiments was developed by means of electricity.

"Wyssokowicz found that the presence of ozone in a culture medium restrained the development of the anthrax bacillus, the bacillus of typhoid fever, and others tested, but concludes that this is rather due to the oxidation of bases contained in the nutrient medium than to a direct action upon the pathogenic bacteria.

"Sonntag, in his carefully conducted experiments, in which a current of ozonized air was made to pass over silk threads to which were attached anthrax spores, had an entirely negative result. The anthrax bacillus from the spleen of a mouse, and free from spores, was then tested, also with a

negative result, even after exposure to the oxonized air for twenty minutes at a time on four successive days. In another experiment several test organisms (Bacillus anthracis, Bacillus pneumoniæ of Friedlander, Staphylococcus pyogenes aureus, Staphylococcus pyogenes albus, Bacillus muriseptiicus, Bacillus crassus sputigenus) were exposed on silk threads for twenty-four hours in an atmosphere containing 4.1 milligrammes of ozone to the litre of air (0.19 volumes per cent.). The result was entirely negative. When the amount was increased to 13.53 milligrammes per litre the anthrax bacillus and Staphylococcus pyogenes albus failed to grow after twenty-four hours' exposure. The conclusion reached by Nissen, from his own experiments and a careful consideration of those previously made by others, is that ozone is of no practical value as a germicide in therapeutics or disinfection."

From a practical point of view the use of the X-ray in the practice of the Chicago doctor, to whom the above quoted explanation of its therapeutic action is attributed, appears to have been quite successful. He says:

"For the last eight months I have had patients under the X-ray in my laboratory from 9 a. m. to 6 p. m., duration of treatment varying from a-half to four hours at each treatment, and not once with any bad result in any case."

Now it is evident that a physician who has patients coming to his office from 9 a. m. to 6 p. m. every day is in the enjoyment of a very handsome professional income. And if, as I imagine, many of these patients are well-dressed ladies with more leisure than judgment, they are no doubt satisfied to pay well for the opportunity of having the latest *scientific* treatment applied to their cases and to await their turn in the anteroom of this distinguished 'professor of electro-therapeutics.'

The article from which we have quoted, and which appears to answer all the purposes of a free advertisement, concludes as follows:

"It must not be forgotten that electric phenomena are very powerful, and not every man who can buy a machine is capable of applying it. The electric machine must be as skillfully adjusted to each individual as the microscope to a specimen submitted to it. It is a treatment full of danger if ignorantly or rashly handled, but beyond price in value to the skilled and careful electro-therapeutist."

We do not propose to prejudge the question of the possible therapeutic value of the X-ray, but we think it safe to predict that it will not be found of any value for the destruction of pathogenic bacteria in the tissues, inasmuch as it has been shown by several competent observers to have very little, if any, germicidal action; and because there is no experimental evidence which justifies the belief that these low vegetable organisms can be destroyed by any physical or chemical agents which would not at the same time destroy the vitality of the less resistant cellular elements of the tissues.

If time permitted I might further illustrate the temporary successes of recent pseudo-scientific discoveries by referring to the 'cryptococous xanthogenicus' of Domingos Freire, of Brazil, the Bacillus malariæ of Klebs and Tomasi Crudelli, etc., etc.

The spectacle of a learned clergyman, supplied by nature with a brain and a pair of lungs, sitting day after day with an 'electropoise' attached to his leg for the purpose of 'taking on oxygen freely from the atmosphere' recalls the 'blue grass craze' of twenty-five years ago.

George M. Sternberg.

Washington, D. C.

The American Psychological Association.

The fifth annual meeting of the American Psychological Association was held in Boston, Tuesday and Wednesday, December

29 and 30, 1896, under the presidency of Professor G. S. Fullerton, of the University of Pennsylvania. There were three formal sessions of the Association, one on the morning of the 29th, held at the Harvard Medical School, and two sessions on the 30th, held at the Peabody Museum of Archæology in Cambridge. The members of the Association very generally attended the discussion on 'The Inheritance of Acquired Characteristics' before the American Naturalists on the afternoon of the 29th, psychology being represented in the discussion by Professor James, of Harvard. Together with the other affiliated societies, the Psychologists were present at Mr. Agassiz's lecture and reception on Tuesday evening, at the luncheon given by the President and Fellows of Harvard College on Wednesday, and at the formal dinner of the societies at the Hotel Brunswick in Boston, on Wednesday evening. There were forty-five members in attendance, the largest meeting since the organization of the Association. Owing to the number of distinctly philosophical papers, one session of the Association was given up to papers of that character. The scientific program was as follows:

1. *The Physiology of Sensation.* By E. A. SINGER, of the University of Pennsylvania.

States the fundamental question as: What would be an ideally complete physiology of sensation? The method employed in answering the question would establish an analogy between what has been regarded as progress in the past and what should be sought by a progressive psychology of the future. The result of such an analogy is stated in the following form: Wherever we know anything about the psychology of sensation we find that the correlate of a mental difference is a structural physiological difference. Where we are yet in ignorance as to the physiological counterpart of a mental difference we should assume it to be a difference in structure rather than a difference in functioning of the same structure. This view is to be contrasted with such opinions as would regard the physiological counterpart of intensity as the greater or less activity of the same nervous structure; feeling tone as the greater or less disintegration, or as dependent upon conditions of greater or less nutrition of the same structure, etc. Some attempt is made, rather by way of illustration than as framing a completely tenable hypothesis, to suggest a physiology of these so-called properties of sensation that would relate them to quality of sensation. Thus the physiological basis of intensity differences is sought in part in the different end organs affected in greater or less reaction to a stimulus; in part also in special apparatus suggested by the allied nature of intensity and saturation in color sensations. Feeling tone is distinguished from pleasure and pain; the physiology of the former being related to that of the emotion, the physiology of the latter to that of the special senses. Local sign presents the inverse problem as to how sensations conditioned by confessedly different nervous structures should come to be classed together. The answer suggested is that the classing together of locally different sensations and qualitatively similar is conditioned by the formal likeness of the end organs affected, they determining a likeness in the adequate stimuli and in the general way of behaving of the sensation. Recognized likeness and difference of sensations are found to involve psycho-physical reflection.

2. *Intensity of Sensation.* By JAMES E. LOUGH, of Harvard University.

Sensations forming an intensity series have this characteristic which distinguishes them from a qualitative series, namely, that the intensity series goes towards or from

zero—the vanishing point—while a purely qualitative change leads neither to or from the zero point of sensations. Theories of intensity of sensations may be classed in general under two heads: (*a*) that the stronger sensation *is* the weaker sensation plus more of the same sensation—following an analogy from the physical world which may prove dangerous, and exposing psychology to the troublesome presupposition that our psychic elements (sensations) are compounds; (*b*) that the intensity series is merely a qualitative series, but ordered in a series towards or from zero by the presence of a second series of sensations, *e. g.*, brightness sensations or muscular sensations. It would seem much more satisfactory to discover in the nature of the psycho-physical process itself that which shall give to sensations the characteristic of an intensity series. Accordingly this hypothesis is offered: Any sensation of a given quality and intensity that may arise depends upon a certain physiological condition which is reached only after passing successively through a series of other physiological conditions, each of which is but differing in degree from zero to the given sensation. That is, any sensation depends upon the physiological basis which contains, in a temporal series, the bases of all the weaker sensations of this particular quality. The final neural condition, after passing through all the intermediate steps, may be called the 'maximum effect' of the stimulus. By a study of the intensity of sensations produced by a stimulus of a known intensity acting for a time less than that necessary to produce its maximum effect, it is found that this intensity is exactly proportional to the duration of the stimulation. Concerning the nature of the psycho-physical process, nothing is postulated save that the basis of the stronger sensation contains that of the weaker in the time series as stated above.

3. *Report of Experiments on the Reduction of the Tactual Double-Point Threshold by Practice and on the 'Vexirfehler.'* By G. A. Tawney, of Beloit University.

The first object of the experiments was to examine the view of Volkmann and Fechner that, by daily practicing some one spot of skin in the perception of two points, the threshold for this perception is reduced, not only for the spot actually practiced, but also for the symmetrically opposite spot on the other side of the body. A number of threshold determinations were made on different parts of the body varying in number from six to thirty-two for each subject. One of these spots was chosen for special practice, which continued for a period varying from two weeks to a month. At the end of this time the threshold determinations on the six to thirty-two different parts of the body were repeated in order to compare them with those made at the beginning of the practice series. The instrument used was a simple pair of compasses. The results show unmistakably that where any reduction of the threshold occurs as a result of practice it occurs over the entire surface of the body; it demands, therefore, a central explanation. The paper further discussed the nature of the 'Vexirfehler' (double-point illusion). It was assumed that the double-point illusion is the result of suggestion and it was sought to free a subject whose threshold formerly could not be determined from the suggestion involved. The experiments seemed to show that the reduction of the threshold by practice is, to a great extent at least, a result of suggestion. Several series were carried out for the purpose of studying the psychosis underlying the 'Vexirfehler.' The results seem to show that this illusion is mainly due to auto-suggestion, although physiological factors may play a subordinate part.

4. *Comparison of the Times of Simple Reactions*

and of Free-Arm Movements in Different Classes of persons. By ALBERT L. LEWIS.

This paper gave the results of nearly 9,000 experiments on American men and women and on male negroes and Indians. The relative order of these four classes in reacting to sound was found to be arranged from shortest to longest, Indians, American men, Negroes and American women; to light; American men, Indians, American women, Negroes; to touch; Indians and American men the same, Negroes third, American women fourth. With regard to the mean variations of the average reaction times, the order was: in sound; American men, Indians, American women; in light, American men, Indians, Negroes, American women; in touch; Indians, American men, American women, Negroes. The conclusion is drawn that there are characteristic variations in the reaction time and rate of movement of classes of persons; that a close relation exists between reaction time and rate of movement; that a number of reactions is necessary to give a characteristic result in each individual case.

5. *Researches in Progress in the Psychological Laboratory of Columbia University.* By J. MCKEEN CATTELL.

Among the subjects in course of investigation the following were mentioned as likely to be completed soon. Mr. W. Lay, lately Fellow in Philosophy, has, for several years, been studying mental imagery by various methods. In addition to questions such as those proposed by Mr. Galton, others have been set more independent of immediate introspection and extending to auditory and motor imagery. Among others, including musicians, 100 leading artists have, in letters and interviews, described their imagery. Imagery has been investigated by its effects on memory, and in the compositions of poets and other writers. Mr. Lay has, finally, given special attention to his own imagery and associations. Mr. S. I. Franz, Fellow in Psychology, is investigating after-images. He has already published experiments on the threshold for after-images, and is now studying the duration and nature of the after-image as dependent on the intensity, duration and area of stimulation. He is able to correlate the effects of these magnitudes for consciousness and to analyze physiological and mental factors. The individual differences are of interest, for, with the same stimulus, the image differs greatly with different persons. Mr. L. B. McWhood, Fellow in Psychology, is studying the motor accompaniments of the perception and emotional results of music. The movements are a series of taps made as rapidly as possible and a pressure not a maximum, but kept as nearly as may be constant. The subject decides on his preferences, etc., for the tones and combinations used, and these are compared with the motor effects. Mr. H. E. Houston, Scholar in Psychology, is studying color nomenclature with special reference to children. The growth in accuracy and extent of the color vocabulary in schools has been determined, and the attempt will be made to find and set a normal nomenclature for colors and other classes of sensations. Other researches were mentioned but not described.

6. *The Psychic Development of Young Animals and its Somatic Correlation with special reference to the Brain.* By WESLEY MILLS, McGill University, Montreal.

This paper was based on researches on psychic development and on the development of the cerebral cortex in the same groups of animals. As somatic correlation other than that of the brain has been considered in other papers, this phase of the subject was not especially treated in this paper. The main conclusions are as fol-

lows: In the dog and the cat there is a period extending from birth to about the time of the opening of the eyes characterized by reflex movements, the sway of instincts and the absence of intelligence. The advance in movement, first of the limbs and later of the head and face parts, together with the psychic progress associated with this, is correlated with rapid development of the cortical centers for the limbs in the first instance, and later for the head and face in the period immediately following the blind stage. This is more rapid and more pronounced in the cat than in the dog, and is correlated with greater control in the cat over the forelimbs and with certain physiological and psychic developments characteristic of the cat; similar observations were made upon rabbits and cavies. The psychic manifestations of the pigeon and fowl have not the same sort of cerebral cortical correlates as the animals referred to above.

7. *The Organization of Practical Work in Psychology.* By Lightner Witmer, of the University of Pennsylvania.

Under the designation of practical work in psychology was included: (1) The direct application, whether by professional psychologists, practicing physicians or teachers, of psychological principles to therapeutics and to education. (2) Such psycho-physical investigation of mental conditions and processes as may serve to throw light upon the problems that confront humanity in the practice of medicine or teaching. (3) The offering of instruction in psychology to the students of medicine or to teachers that contains a promise of future usefulness to them in their respective professions. Thus the plan has a view to the professional practice of psychology, to research and to instruction as these stand related to the two professions of medicine and teaching. In order that psychology may become a useful possession of the medical man, details of organization must be perfected that will bring about a union of the department of psychology with the professional departments of the medical school. Professor Witmer then went on to suggest details of organization as part of a plan for the development of research work and instruction useful to the community and to the teacher.

8. *Psycho-physical Tests on Normal School and Kindergarten Pupils.* By Miss Mary P. Harmon.

These tests form part of a general scheme which proposes the development of a series of tests which shall be applicable alike to the oldest and youngest pupils in all grades from the kindergarten to the normal school. The intention is to repeat, from year to year, a series of experiments of which a few are included in this preliminary report, as the children now in the kindergarten pass through the various grades. The tests reported upon included family statistics, age, height, weight, lung capacity, simple reaction time to sound and rate of free-arm movement.

9. *Personal Experiences under Ether.* By Wesley Mills, of McGill University, Montreal.

This paper related the experiences of the writer during and immediately subsequent to the adminstration of ether, together with a later experience that seemed to produce a profound impression.

Brother Chrysostom, of the Manhattan College, presented an informal paper, entitled *A Preliminary Study of Memory;* and Professor E. C. Sanford, of Clark University, gave a *Demonstration of an Eye Plethysmograph.*

A paper by Mrs. C. Ladd Franklin, on *Color Blindness and Willem Pole: A Study in Logic,* was read by title.

The titles of the philosophical papers

read on Wednesday morning were as follows:

1. *Philosophy in the American Colleges.* A. C. ARMSTRONG JR., Wesleyan University.
2. *Tests of Current Theory Touching Mind and Body.* DICKINSON S. MILLER, Bryn Mawr College.
3. *The Relation of Mind and Body.* C. A. STRONG, Columbia University.
4. *Is the 'Transcendental Ego' an Unmeaning Conception?* J. E. CREIGHTON, Cornell University.
5. *The Relation of Pessimism to Ultimate Philosophy.* F. C. S. SCHILLER, Cornell University.
6. *The Standpoint and Method of Ethics.* JAMES SETH, Cornell University.
7. *A Generalization of Immediate Inferences.* J. G. HIBBEN, Princeton University.
8. *The Negative in Logic.* A. T. ORMOND, Princeton University.

The afternoon session on the 30th was opened by the address of the President, Professor Fullerton, of the University of Pennsylvania, entitled *The 'Knower' in Psychology.* It was an examination of the nature of knowledge from the standpoint of the psychologist, and the criticism of the 'self' in its knowing function, as it is familiar to readers of philosophy and psychology. Professor Fullerton criticised the Neo-Hegelian doctrine of the '*self*' as a unifying activity in consciousness, and also the view of the self that regards it as a noumenon or metaphysical entity lying behind consciousness and accounting for it. The positive views advanced by the speaker were as follows: The idea that there must be a self distinct from the contents of consciousness to explain consciousness arises out of a mere misconception, and is to be regarded as a survival from an unreflective past. The primary uncritical notion of the self identifies it with the body. In animism we have a duplicate of the body regarded as the self, the knower and doer. In the history of philosophy this notion is made more abstract and unintelligible with the progress of reflection, and in successive systems the function of the self as knower becomes more and more unmeaning. But knowledge is a psychosis like any other psychosis, and it is the duty of the psychologist to analyze and describe it. He must, moreover, use the same psychological method which he uses in treating of sensations or of any other mental elements, and must not try to find an explanation of knowledge by having recourse to a something which lies beyond the realm of psychology as science.

Following the President's address there was held a business meeting of the Association, and a report from the Committee on Physical and Mental Tests, appointed the year before, was presented and accepted. This report is reproduced, as the elaboration of such tests is a matter that concerns several sciences.

PRELIMINARY REPORT OF THE COMMITTEE ON PHYSICAL AND MENTAL TESTS.

The Committee on Physical and Mental Tests appointed at the last annual meeting of this Association submits the following report:

The committee has drawn up a series of physical and mental tests which is regarded as especially appropriate for college students tested in a psychological laboratory. The same series would also be suitable for the general public and, with some omissions and slight modifications, for school children. The committee has had in view a series of tests requiring not more than one hour for the record of one subject. In selecting the tests and methods the committee regarded as most important those which seemed likely to reveal individual differences and development, but also took into account ease and quickness in making the tests and in interpreting and collating the results.

Each member of the committee selected a complete series of tests. The report includes these selections, together with brief descriptions of methods. After each test and method are placed the initials of the members of the committee recommending it.*

Preliminary Data: B. C. J. S. W.

Date of birth; birthplace; birthplace of father; birthplace of mother; occupation (including class in college, or, if not a student, the last educational institution attended); occupation of father; any measurements previously made. B. C. J. S. W.

Color of eyes; color of hair; right or left-handed. B. C. J. S.

Mother's maiden name; number of brothers; sisters; order of birth; age of parents at birth; birthplace and occupation of grandparents. W.

Two schedules of observations and records to be filled in, one by the recorder and one by the subject, as in the Columbia tests, with such modifications as experience shall make desirable. C.

A blank to be filled in by the recorder, noting asymmetry of head or body, color of eyes and hair, complexion, degenerative or other stigmata of head, eyes, ears, mouth, teeth, hands or feet, posture, gait, manner, coordination and speech, indications of intellectual, emotional and moral characteristics. W.

Physical Measurements: C. J. S. B. W.

Height, weight and size of head. C. J. S. B. W.

Breathing capacity. C. J. S. W.

Height sitting. C. W.

* We refer especially to two publications for descriptions of some of the tests: *Official Catalogue of Exhibits*, Department M., World's Columbian Exposition; *Section of Psychology*, Joseph Jastrow in charge, 1893; and Physical and Mental Measurements of the Students of Columbia University, J. McKeen Cattell and Livingston Farrand, *Psychological Review*, Nov., 1896. The following papers on the subject may also be mentioned: 'Mental Tests and Measurements,' J. McK. Cattell, with an appendix by Francis Galton, *Mind*, 1890; Zur Individual Psychologie, Hugo Münsterberg, *Centralblatt f. Nervenheilkunde und Psychiatrie*, 1891. Researches on the Mental and Physical Development of School Children, J. A. Gilbert, *Studies from the Yale Laboratory*, 1895; reported also by E. W. Scripture, *Zeitschrift f. Psychologie*, etc., X., 1896, and *The Psychological Review*, III., 1896; Der Psychologische Versuch in der Psychiatrie, Emil Kraepelin, *Psychologische Arbeiten*, 1895; La Psychologie Individuelle, A. Binet et V. Henri, *L'Année psychologique*, 1896.

The measurements should be made in the metric system. The weight should be taken in ordinary indoor clothing. The height should have the height of the heel subtracted. At least the length and breadth of the head should be measured. B. C. S.

Keenness of Vision: B. C. J. S. W.

The maximum distance at which diamond (4½ point) numerals can be read with each eye singly. B. C. J. S.

The illumination should be in the neighborhood of 100 candle-meters; about eight out of ten numerals should be read correctly at the rate of about 2 per second. The minimum distance should also be determined, if possible. B. C.

In addition or as a substitute, drawing a series of forms as recommended. J.

Use Snellen Test-types. S.

Some other substitute for these tests, to be suggested after satisfactory trial. W.

Color Vision: B. C. J. S. W.

Select as quickly as possible four greens from a series of wools; measure the time; if long, make further tests. C.

Combine with test of rate of perception by requiring subject to name, as rapidly as possible, a series of colors, either wools or papers. B. W.

Use the chart exhibited at the World's Fair. J.

Keenness of Hearing: B. C. J. S. W.

The distance at which a continuous sound can be heard with each ear singly. C. B. W.

Use some artificial external meatus if the test is to show small differences in sensibility. W.

The sound should be from a watch reduced to a standard. An arrangement should be used, by which it can be periodically cut off without the knowledge of the subject. C. S. B.

Use for this a stop-watch. J. S.

I endorse the stop-watch; it can be manipulated, so that the time is recorded, showing how long it took the subject to decide that the watch has stopped. J.

Perception of Pitch: B. C. J. S.

Adjust one monochord or pipe to another, the tones not to be sounded simultaneously. C. J.

Select a match from a set of forks, making a fixed number of vibrations per second more or less than a standard, *e. g*, standard 500 v. per second; other forks, 497, 497.5, 498, 498.5, etc.; 500, 500.5, 501, etc. B. S.

I prefer the adjustment to the selection method. The test can be made with two Gilbert tone-testers. J.

Fineness of Touch: C. J. S. W.

The æsthesiometer is unsatisfactory; the discrim-

ination of roughness of surfaces and touching a spot previously touched should be tried. C. J. W.

Sensitiveness to Pain: B. C. J. S. W.

The gradually increasing pressure that will just cause pain. The point or points in the body to be used to be agreed upon. B. C. J. W.

Perception of Weight or of Force of Movement: B. C. J. S. W.

Arrange a series of weights. B. J. W.

Make movements of equal force and determine the error. C.

The best method still to be developed. J.

Dynameter Pressure of Right and Left Hands: B. C. J. S. W.

Dynamometer. B.

In place of or in addition to the ordinary dynamometer test make movements of the thumb and forefinger and continue as rapidly as possible for fifteen seconds. C.

Use mechanical counter for this and take reading at end of every minute. S.

Thumb and finger dynamometer. Record best and worst of five trials. W.

Rate of Movement: W.

Distance of 35 cm. One preliminary trial with right hand in extension, then two trials in succession of R. E., L. F., L. E., R. F. Collate shortest of two trials under each typical movement. W.

Fatigue: B. C. W.

Muscular exertion. B. W. As described above. C.

Intellectual exertion. B. W.

Will Power: W.

The ability of the subject to respond after fatigue has set in to a suggestion of the experimenter with an extra effort of will. W.

Voluntary Attention:

Test by simple mental operations under distraction. B.

Coincident variations in Psycho-physical process. W.

The modifiability of the knee jerk, or of a sustained bodily process, such as rate of breathing or pulsation of a volitional muscular or intellectual process, when the subject's attention is engaged by some mental content. W.

Measure at the same time concentration or distraction of attention. W.

Right and Left Movements: J. W.

The accuracy with which movements are made to the right and left. J. W.

Some such test as this for indication of right and left-handedness. W.

I do not insist on this test as one of great importance. J.

Rapidity of Movements: C. J. S. W.

Taps on a telegraph key. J. W.

Movements requiring force, as described above. C.

Make short marks as rapidly as possible for twenty or thirty seconds, *e. g.*, | | | | |. S.

Trilling with two fingers and with five. W.

Accuracy of Aim: B. J. S. W.

Throwing a marble at a target. J.

Or striking a point upon the table with a pencil point. W.

Touch an insulated spot, as proposed by Scripture. S. B. Also for steadiness of hand. B.

Reaction-time on Sound: B. C. J. S. W.

The reaction to be made with the right hand with a signal about two seconds before the stimulus. B. C. J. W.

Five reactions to be made without preliminary practice; after the reactions have been made, the observer to be asked whether the direction of the attention was motor or sensory. B. C.

It is not much use to ask for direction of attention with most subjects. W.

Sensory and motor reaction with instruction, after the above test. B.

Reaction-time with Choice: B. J. W.

Use card sorting. B. J. S.

Rate of Discrimination and Movement: B. C. J. S. W.

100 A's in 500 letters to be marked or as many as can be marked in one minute. B. C.

One out of a number of geometrical forms to be marked: determine the number marked in 90 seconds. J. W.

Or colors, or pictures of objects. W.

Quickness of Distinction and Movement: B. J. S.

Rate at which cards are sorted. B. J. S.

Combine with reaction with choice. B.

With the effects of practice, etc., as proposed by Bergstrom. S.

Perception of Size: C. J. S. W.

Draw a line equal to a model line 5 cm. in length, bisect it, erect a perpendicular of the same length and bisect the right-hand angle. C. J.

Perception of Time: B. C. J. S. W.

The accuracy with which a standard interval of time, say ten or twenty seconds, can be reproduced. C. W.

Thirty seconds or one minute. W.

Memory: B. C. J. S. W.

The accuracy with which eight numerals heard once can be reproduced and the accuracy with which a line drawn by the observer at the beginning of the hour can be reproduced at the end of the hour. C. W.

Line to be identified. Ten numerals to be used. B.

Nine numerals. S.

A combined test of memory, association and finding-time as described in the catalogue of the Columbian Exposition. J. W.

Accuracy of observation and recollection as proposed by Cattell and by Bolton. J. W.

Memory-type: B.

Variations in use of 10 numerals; method as follows:

1. Show numerals in chance order and have subject write them from memory after an interval.

. Speak numerals in chance order and have subject write them from memory after an interval.

. Show and speak in chance order and have subject write them from memory after an interval.

4. Show and have the subject speak them and then write them from memory after an interval.

Compare the results for indications of memory type and kind of imagery preferred. Question the subject as to his mental material in each case. B.

Apperception test of Ebbinghaus. B.

Imagery: B. C. J. S. W.

Questions proposed in the Columbia tests. C.

Methods should be worked out more fully. C. J. W. B.

Cf. Method under preceding head. B.

Make memory span tests, showing and speaking the digits at the same time, and ask the subject which sense (sight or hearing) he found himself using, and if either seemed to him a distraction. S.

The committee urges that such tests be made, so far as possible, in all psychological laboratories. It does not recommend that the same tests be made everywhere, but, on the contrary, advises that, at the present time, a variety of tests be tried, so that the best ones may be determined. Those who make tests which they regard as desirable are requested to send these with sufficient descriptions to the committee.

The committee hopes that the tests proposed may be discussed fully at the present meeting of the Association, and asks that the present committee be continued for another year.

(Signed,)
J. Mark Baldwin,
Joseph Jastrow,
E. C. Sanford,
Lightner Witmer,
J. McKeen Cattell, *Chairman.*

At the business session the following officers were elected: President, Professor J. Mark Baldwin, of Princeton University; Secretary and Treasurer, Dr. Livingston Farrand, of Columbia University; new members of the Council, Professor Josiah Royce, of Harvard University; Professor Joseph Jastrow, of the University of Wisconsin. The following new members were elected: Professor G. H. Palmer, Harvard University; Professor J. G. Hibben, Princeton University; Professor R. B. Johnson, Miami University; Professor F. C. French, Vassar College; Dr. E. F. Buchner, Yale University; Dr. Ernest Albee, Cornell University; Dr. C. H. Judd, Wesleyan University; Dr. Alice J. Hamlin, Mt. Holyoke College; Dr. G. A. Tawney, Beloit University; Mr. F. C. S. Schiller, Cornell University; Dr. C. W. Hodge, Princeton University; Mr. J. F. Crawford, Princeton University; Dr. C. F. Bakewell, Harvard University; Dr. David Irons, University of Vermont; Dr. Robert McDougall, Western Reserve Uuiversity; Mr. A. F. Buck, Union College.

An invitation was received from the British Association for the Advancement of Science to attend the next annual meeting to be held at Toronto, Canada, as members of the Section of Physiology. Upon the recommendation of the Council, it was moved and carried that such members of the Council as are able to attend be official delegates of the Association to the meeting and that such members of the Association as may be able, accept the invitation to attend

as members. An invitation was also received from the American Association for the Advancement of Science to join that Association. The Council recommended that all members who might feel so disposed present their names for election to that Association.

The time and place of the next meeting of the Association was left to the President to be decided in consultation with the Presidents of the affiliated societies.

After a vote of thanks for the hospitality extended to the Association the meeting adjourned.

LIVINGSTON FARRAND,
Secretary.

COLUMBIA UNIVERSITY.

THE AMERICAN FOLK-LORE SOCIETY.

THE eighth annual meeting of the American Folk-lore Society was held at Columbia University on December 29th.

During the past year the Society has lost two of its most esteemed members—its President, Capt. John G. Bourke, and Professor Francis J. Child, one of its founders and its first President.

The Society elected Professor Sidney A. Hartland and Dr. H. Steinthal honorary members.

The officers elected for 1897 were as follows:

President, Mr. Stewart Culin, of the University of Pennsylvania; 1st Vice-President, Dr. Henry Wood, of Johns Hopkins University; 2d Vice-President, Dr. Franz Boas, of Columbia University; Permanent Secretary, Mr. W. W. Newell, Cambridge, Mass; Treasurer, Dr. John H. Hinton, of New York City.

To facilitate closer cooperation with other scientific societies and to afford individuals greater opportunities to receive benefit from kindred organizations, the Permanent Secretary was authorized to arrange the time and place of the annual meeting and was instructed to give preference to the time and place of meetings of the American Psychologists and Society of Naturalists. The Permanent Secretary was further authorized to call a summer meeting at the time and place of the meeting of the American Association for the Advancement of Science.

The Society has recently published a volume of Current Superstitions, by Mrs. Fanny D. Bergen, and it has now in press a volume entitled Navaho Legends, by Dr. Washington Matthews.

A full programme of papers was presented, of which only a part can be here mentioned.

Miss Alice C. Fletcher's 'Notes on Certain Early Forms of Ceremonial Expression' developed the idea that among savage peoples the burden of the song is, to a greater extent than heretofore recognized, correlated with the emotion which the song is desired to express. Miss Fletcher has investigated this subject specially among the Omahas, and her studies in this direction are still in progress. Incidentally, the accuracy of repetition and pure preservation of native songs was mentioned; an example being an Omaha song, recorded by means of the phonograph, which agreed in every detail with the same song as collected twelve years prior.

'Ceremonial Hair-Cutting among the Omahas' was treated by the same speaker. The hair has been associated with strength in the lore of many peoples and has been treated as of close connection with the life and reality of the individual. Thus some peoples when giving a name and thus adding an important part to the personality of an individual think it necessary to counterbalance this act by cutting off a portion of the hair.

Mr. W. W. Newell's paper on 'The Legend of the Holy Grail' was intended to suggest that literary productions, under certain circumstances, may develop into folk-tales.

Dr. Robert M. Lawrence spoke of the many superstitions connected with common salt even among our own people.

Mr. Stewart Culin exhibited a number of Divinatory Diagrams from Tibet, China, Mexico, etc., and called attention to their similarity as well as to the fact that they, being arranged on a plan of four quarters, might be developed from the idea of the four cardinal points.

'An Ojibwa Myth,' by Harlan I. Smith, referred to the white-dog sacrifice and ideas common to several of the neighboring tribes.

'The Psychic Origin of Myth,' by Dr. D. G. Brinton, was an inquiry into how far the psychic unity of man satisfactorily accounts for similarities in myths found among widely separated peoples. Dr. Brinton's position that it accounted for even minor details was vigorously contested by several present.

Mr. Stansbury Hagar contributed from his store of Micmac mythology such parts as related to weather and the seasons.

Miss Whitney, Secretary of the Baltimore Branch of the Society, contributed a paper on the lore of 'The Sword and Belt of Orion or De Los Ell an Yard.' It seems that this group of stars in the constellation of Orion holds an important place in the folk-lore of the negroes.

Dr. Franz Boas related 'A Star Legend from the Interior of Alaska and its Analogues from the other parts of America.' While holding to the idea generally accepted among scientists, that the same fundamental concept may arise independently among widely separated peoples having no contact, and due purely to the same psychic phenomena common to man; yet he held that similarity in a long series of minor details, especially in cases where contact was possible, could not be positively accounted for in that way and that historic influence must be considered as well as psychic unity.

Mr. W. S. Scarborrough's paper on 'Negro Songs' was an interesting contribution on the play songs of negro children.

'The True Story of Blue Beard,' by Professor Thomas Wilson, illustrated the making of folk-lore, the changing of a historic story to a legend by continual repeating with slight change, in a way exactly opposite to the accurate repetition of the Omaha song.

A public lecture was given in the evening by Mr. Heli Chatelain, on 'African Life Illustrated.' Mr. Chatelain, who was late United States Commercial Agent in Angola, spoke very feelingly against the existing Arab slave trade, while his main subject was the ethnology of the Negroes of Angola, from whom he collected the volume of folk-tales recently published by the Society.

The meeting concluded with the annual dinner. In this the Society was joined by the Section of Anthropology of the American Association for the Advancement of Science, with which it is closely affiliated.

Harlan I. Smith.
American Museum of Natural History.

HORATIO HALE.

In the death of Mr. Horatio Hale, which took place at Clinton, Ontario, December 28th, science in America has lost an earnest worker and student, who for more than half a century has been prominent in linguistic and ethnographic literature. Indeed, it is sixty-three years since his first contribution to science was printed—a small pamphlet on an Algonquian dialect. He was born May 3, 1817, at Newport, N. H., and was at the time of that publication a student in Harvard College.

He graduated in 1837 and was immediately appointed as 'philologist and ethnographer' to the United States exploring expedition under Captain Charles Wilkes. His report constituted the seventh volume

of the series published by the expedition and makes a stately volume of 666 pages. It is filled with extremely valuable material relating to the ethnology and dialects of the various tribes encountered by the expedition, especially in Patagonia, Polynesia, Australia, South Africa and the northwest coast of North America. The grammar and comparative vocabulary of the Polynesian dialects are especially creditable, and Mr. Hale's studies of the migrations of the Polynesians and the peopling of the islands of the Pacific ocean may be justly said to have laid the foundation for all subsequent researches in that field. In their main outlines they have stood the test of later inquiry, and are accepted to-day by the soundest anthropologists.

Ten years after the publication of this volume (1846–1856), he removed to Clinton, Ontario, Canada, where he resided the remainder of his life, practicing law, but always in touch with the progress of his favorite scientific studies. His contributions to these, though not very numerous, were ever marked by an intimate knowledge of facts and deep and original reflection.

One of the most important of his works was the translation and editing of 'The Iroquois Book of Rites,' forming the second volume (pp. 222) of the 'Library of Aboriginal American Literature.' This valuable native document was printed in the original text, with a learned introduction and notes.

Mr. Hale was the first to discover the presence of the Siouan stock on the Atlantic coast by identifying the Tutelo of Virginia as a dialect of the Dakotan family. In two essays, one on 'The Origin of Languages' and the other on 'The Development of Language' (1886 and 1888), he brought forward and ably supported a reasonable and probable theory for the rise and extension of independent linguistic stocks, many of which are often found in limited areas. It is enough to say of these papers that their argument is masterly and that no other theory more acceptable has yet been presented to the scientific world.

In a later essay (1893), on 'Language as a Test of Mental Capacity,' he defended the value of linguistics as a criterion for ethnic classification; though in the development of this argument, he was somewhat hampered by his opinions as to the relations of savage to civilized conditions. In the same year a paper by him, on 'The Fall of Hochelaga,' set forth for the first time the early history of the Huron-Iroquois tribes.

Mr. Hale was an active member of the American and British Associations for the Advancement of Science, and was one of the founders of the Anthropological Sections in both. In 1886 he was Vice-President of the former and Chairman of the Section on Anthropology. He was also a President of the American Folk-lore Society, and an honorary or corresponding member of many learned associations.

In his village home he was constantly active in educational plans and in those tending to the development of the best interests of the community. Personally he was affable and considerate, and in the warmth of scientific discussions never forgot the courtesies of life, several times in this respect setting a much-needed example to his opponents.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

EMIL DU BOIS-REYMOND.

EMIL DU BOIS-REYMOND, the eminent physiologist and philosopher, died in Berlin on December 26, 1896, at the age of 78. He was the last of those four bright stars which illuminated the horizon of natural sciences for more than half a century. They are all gone now. Brücke died first (1892); then Helmholtz (1894); then Carl

Ludwig; and now du Bois-Reymond, last but not least, has passed away. These four eminent men who made everlasting marks in science have been life-long friends. All four were pupils of that grand master Johannes Müller. All four started out on their phenomenal scientific careers in the beginning of the forties and, though each one worked in a different line of research, they all had one object in common, which was paramount to them, and that was the liberation of the biological sciences from the deadening grasp of the obscure natural philosophy of those days, and the building up of physiology on a scientific rational basis. In combating the paralyzing idea of a 'vital force,' none was as energetic, none as perseverant as du Bois-Reymond. Only recently the old warrior in service of rational science again entered the arena to fight the old enemy in disguise, the 'neovitalism' of a Bunge, a Rindfleisch and others. Du Bois-Reymond and the other great physiologists are no more, and there is at present no one to fill their places. Who will protect physiology against the onward course of these new 'vital forces.'

E. du Bois-Reymond was born on November 7, 1818, in Berlin. He received there his general education at the College Français, and in 1837 he entered the University of Berlin, where he registered at first in the philosophical faculty, attending various lectures on philosophy, history and even theology. An accidental attendance at one of the lectures of Mitscherlich on experimental chemistry, however, had a deciding influence upon du Bois-Reymond's future. He began to study mathematics and the natural sciences, and went over later to the study of medicine, thus coming in contact with Johannes Müller, who was at that time the professor of physiology and anatomy at the University of Berlin. Du Bois-Reymond became first the 'famulus,' and later on the assistant, of Johannes Müller. In 1846 he established himself as 'privat-docent' at the University, and in 1855 he was made 'professor extraordinarius.' In 1858, after Müller's death, the chair of physiology was separated from that of anatomy, and du Bois-Reymond was made professor of physiology and director of the physiological laboratory in the University of Berlin, a position which he held to the last day of his life. In 1851, at the proposition of Alexander von Humboldt and Johannes Müller, du Bois-Reymond was elected to the *Berliner Academie der Wissenschaft*, a very high honor for a young man of only 33 years, and since 1867 he was the permanent secretary of the academy. Du Bois-Reymond was an honorary member of numerous scientific societies all over the Old and the New World.

The brilliant scientific carer of du Bois-Reymond was again determined by a single accident. In 1841 Johannes Müller handed to his amanuensis Matteucci's paper (Essai sur les phénomènes électriques des Animaux, Paris, 1841) for the verification of the experiments on the so-called frog current of Nobili. It became the task of du Bois-Reymond's life, and he solved it by creating a new science, the science of animal electricity. Already, a year later, appeared his first short paper on this subject (Ueber den sogenannten Froschstrom und die electromotorischen Fische, Poggendorff's Analen der Physik, Vol. 58), and was followed by his thesis (Quæ apud veteres de piscibus electricis extant argumenta, 1843). Then years of silence followed, years of hard labor, of seclusion in his small private laboratory, where 'the frog and the multiplicator were the whole world' to that most energetic of all investigators. The problems, the methods, the instruments, were thoroughly worked out with unparalled energy, ingenuity, precision and self-criticism, before they were communicated to the world. But then, when his book on animal electricity came out, it was a revelation, it marked an

epoch in physiology. In 1848 appeared the first volume of that book, 'Untersuchungen ueber thierische Elektricität.' In 1849 followed the first part, and in 1860 the second part, of the second volume. It was not simply a communication of new striking facts and new methods; it was an exhaustive statement of the creation and completion of a new science, presented in a brilliant style and in a language unusually clear and full of life and force. His later contributions to the physics of nerve and muscle appeared mostly in the reports of the Berlin Academy of Sciences, or in the Archiv für Physiologie, of which du Bois-Reymond was the editor. Among the fundamental facts which were added by du Bois-Reymond to physiology we have to mention, in first place, the establishment and development of the laws of the muscle current, the discovery of the nerve current, the discovery of the so-called negative variations in muscle and in nerve, the discovery of the electrotonus, etc., etc. Du Bois-Reymond has devised and invented numerous important scientific apparatus, many of which are to be found in all well-equipped physiological laboratories; for instance, the induction coil, the electric key, the non-polarizable electrodes, etc., etc. Du Bois-Reymond's name will live forever in the science of physiology.

Aside from his special scientific work, we should not omit to mention the public speeches (Reden) delivered by du Bois-Reymond on many special occasions. In those speeches, as a rule, an important subject was treated in a classical style. They were models of clearness and brilliancy, and nearly every one of his speeches has been an event in its time, and many of them have been translated into all civilized languages. We need only to mention here the following: 'Darwin *versus* Galiani,' 'Die Lebenskraft,' 'Ueber die Grenzen des Naturerkennens,' with his *ignorabimus*, and 'Die Sieben Welträthsel.' He was as forcible a speaker as a writer. And both his pen and his speech have been employed only for a fearless propagation of high ideals and in defence of the rational principles underlying modern sciences.

His last work was one of love. Shortly before he died he finished reading the proofs of his carefully prepared memorial of his friend Helmholtz.

S. J. MELTZER.

CURRENT NOTES ON METEOROLOGY.

THE PLAGUE AND CLIMATIC CONDITIONS.

THE present outbreak of the plague in India suggests certain considerations with reference to the possible connection of its occurrence with climatic conditions. While it used to be thought that the plague could not occur in the Torrid Zone, it is now known, in view of outbreaks of the disease within the tropics in Arabia and India, that this rule does not hold rigidly. In Egypt the autumn seems to be the season in which the plague appears, and June the month in which it dies out. In Europe, outside of Turkey, the plague season has been summer and autumn. In India no direct connection with the seasons could be detected in the epidemics of 1815–21, the first outbreak concerning which we have trustworthy information, and of 1836–38. From all the data at hand, the general conclusion is that a moderately high temperature favors the development and extension of the plague, but extremes of heat and cold are unfavorable to its breaking out. Exceptions to this rule are many. For instance, in the epidemic at Smyrna in 1735 the heat was so excessive during the plague that many of the people who left the town for neighboring villages died of sunstroke on the way, while in Roumelia, in 1737–38, the plague continued in many places in which the temperature fell at times to 3° Fahr. Regarding the effect of atmospheric mois-

ture there is also some doubt. Some authorities hold that a high degree of humidity is necessary for the epidemic extension of the plague, while others maintain the opposite view. Certainly the occurrence of many outbreaks at high altitudes in Kurdistan, Arabia, China and India makes it clear that a moist atmosphere is not always an essential in the spread of the epidemic. The present outbreak in India, coming at a time when medical men in that country and all over the world are thoroughly alive to the importance of studying the climatic relations of the disease, will undoubtedly result in giving us much additional information in this connection. The occurrence of this outbreak in India at a time of famine recalls the fact that the plague 1815–21 broke out in the island of Cutch in a district where there had been a famine a short time before.

CHINOOK WINDS IN THE NORTHWEST.

THE conditions under which chinook winds occur in the Northwestern States is well illustrated on the Portland, Ore., weather map for December 3d, last. At 5 a. m., Pacific time, on that day an area of low pressure was central over the ocean northwest of Washington, extending over British Columbia and northern Washington, while an anticyclone was central near Salt Lake City. This distribution of pressure naturally resulted in a flow of air from the south and southwest over the States of Washington, Oregon, Idaho and Montana. The temperatures were from 46° to 50° west of the Cascade mountains, and from 24° to 32° east of them. The effect of the mountain ranges in causing an adiabatic warming of the descending air is well shown in the course of the isotherms of 40° and 50°, which run north and south parallel with the mountains in Washington and Oregon, and in the direction of the 30° isotherm, which turns eastward across northern Idaho, running south of Helena, Mont., where the wind was south and came across the Rockies, and then turning northward east of Havre. Our chinook winds are similar to the well-known foehn winds of Switzerland. In both cases they appear as warm and dry winds, blowing down from mountain ranges, and when they occur in winter have the habit of rapidly evaporating the snow which may be on the ground at the time. In Switzerland this habit has gained for the foehn the characteristic name of *Schneefresser*. In the United States the snow-eating quality of the chinook is well known, and is an extremely important factor in clearing away the snow blockades on railroads and in removing the snow from the stock ranges.

R. DEC. WARD.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

ETHNOLOGIC MEDICINE.

THE principles of the general development of the arts applied to medicine is the subject of an article by Dr. J. H. McCormick in the *American Antiquarian* for August last. He points out that in many tribes, geographically remote, at the same stage of culture, similar ideas and methods in reference to the practice of medicine and the power of drugs prevailed. Magical formulas were adopted for the cure of disease, and mysterious and eccentric remedies were in vogue, all quite analogous in like stages of culture everywhere. The conjurations of the ancient Egyptians, *mutatis mutandis*, would pass for those of the Cherokees or Nahuas.

The author draws the just inference that those who assert that such similarities are evidences of historic unity, and that they should be explained by some ancient community of culture, do not correctly apprehend modern psychology. This teaches, as its basic principle, that like conditions lead

to similar trains of thought and those to analogous results.

SACRED SECRET SOCIETIES.

IN *L'Anthropologie* for October there are accounts of two sacred secret societies which illustrate the curious aberrations of religious doctrines, unrestrained by reason.

The society of 'Leopards' exists in Sierra Leone. Their god is represented by a manioc root, stuffed with various holy objects. They are cannibalistic, and the price of initiation is to induce some member of the applicant's family to wander into the midst of the assembly, there to be slain and eaten. The reward is to receive this fetish, which will bring good luck.

The other society, already mentioned by some writers, is that of the Aioi, of Tahiti and some other Polynesian islands. It is composed of both men and women, some belonging to the highest castes. It is devoted to the genesiac cult in its most abnormal forms, and one of its laws is that the members must scrupulously avoid the reproduction of their kind.

The incredibly obscene groups in pottery and metal excavated from the tombs of the Yuncas in Peru can probably be explained by the existence among them of some such religious society.

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NOTES ON INORGANIC CHEMISTRY.

SEVERAL years ago Professor Dunnington, of the University of Virginia, showed that the element titanium was much more widely distributed in nature than had been supposed. Indeed, not only all rock masses, but even all soils, examined by him were found to contain considerable quantities. More recently Professor Charles E. Wait, of the University of Tennessee, has had occasion to analyze the ashes of various vegetable substances for titanium and finds it to be an invariable constituent. The ash of oak contains 0.31 per cent., of apple wood 0.11 per cent., and of cotton-seed meal 0.02 per cent. In coals titanium was found present to the extent of from nearly one per cent. in bituminous coals to over two and a-half per cent. in Pennsylvania anthracite. Titanium thus appears to be one of the most widely distributed elements and it is not improbable that analyses will show that it is also found in animals.

IN the last *Nature* Professor Spencer Pickering comes to the support of Professor Armstrong in his attack upon the theory of electrolytic dissociation of salts in solution. In the course of his article he says: "For a theory to be acceptable it should, at the very least, be reasonably probable, and should not violate any fundamental and well established facts; it should stand the test of any apparently crucial experiments * * * and, I think we may add, it should give some explanation, not simply of the behavior of matter in the condition in question, but also of why matter ever assumes such a condition. The theories of osmotic pressure and ionic dissociation, I believe, have not done this."

THE opening of the Davy-Faraday Research Laboratory in London should mark an epoch in chemical science in Great Britain. This laboratory has been established by Dr. Ludwig Mond at a cost of half a million dollars. $170,000 has been expended in the building and its equipment, while $330,000 remains as an endowment fund. The laboratory is furnished with the most modern instruments and appliances for researches in pure and physical chemistry. In opening the laboratory Dr. Mond said he had named it the Davy-Faraday Research Laboratory, in perpetual memory of those two great pioneers of science who carried out their world-famed and epoch-making researches almost on

that spot, and whose example, he hoped, would stimulate and inspire every one who came to work under that roof. The laboratory is open to persons of either sex and of any nationality who can satisfy the laboratory committee that they are fully qualified to undertake original scientific research in pure or physical chemistry, preference being given to those who have already published original work. The directors of the laboratory are Lord Rayleigh and Professor Dewar.

In the *Comptes Rendus* for December 2d Stanislas Meunier recorded observations on some asphaltic rocks and on the origin of asphalt. From the behavior of bitumenous rocks towards solvents the conclusion is drawn that bitumen is the result of purely mineral reactions, as of the double decomposition of metallic carbids and water.

J. L. H.

ASTRONOMICAL NOTES.

The *Astronomische Nachrichten* of January 4th contains a description by Professor Deichmüller, of a new instrument devised by him for fixing the position of the zenith with a meridian circle. The telescope is pointed approximately at the zenith, and the new instrument is mounted above the object glass. It consists of a circular disc of parallel surfaced glass floating in mercury. The vessel containing the mercury is so shaped that the glass is supported at its edges only, so that it is possible to get an unobstructed view of the sky through the middle portion of the glass. It is thus possible to observe the reflected image of the wires, and then to transfer the position of the zenith to the sky without the use of any graduated circle. The instrument is ingenious, and the principle is novel. Prof. Deichmüller gives some very accordant observations made with it. As in the case of all the floating collimators, however, it will be necessary to make sure that the opposite sides of the mercury do not differ in temperature.

The December Monthly Notices of the Royal Astronomical Society contains an interesting article by Prof. Rambaut, of Dublin, on a method of correcting the rate of an equatorial clock, so as to make the telescope follow very nearly the motion of the stars for the purposes of photography. Professor Rambaut gives formulæ for calculating the effect of refraction upon the apparent rate of diurnal motion of the stars, and shows how this effect can be very nearly compensated by varying the clock rate. In this way the work of the observer can be made much easier.

The Wasburn Observatory of the University of Wisconsin has issued Vol. X., Part I., of its Publications. It contains a series of double-star observations by Professor Geo. C. Comstock.

The director's report of the Harvard College Observatory for the year 1896 has appeared. From it we learn that the new Bruce photographic telescope has been transported to Peru, and successfully mounted at Arequipa.

H. J.

SCIENTIFIC NOTES AND NEWS.

Mr. Charles D. Walcott, the Director of the United States Geological Survey, has been appointed Acting Assistant Secretary of the Smithsonian Institution, with duties confined to the charge of the National Museum. It is understood that Mr. Walcott has not taken the new office permanently and that he does not expect to give his full time to the duties of administration of the affairs of the Museum, these being left largely to the present permanent staff of that institution. He will exercise a general supervision and direction of the affairs of the Museum in addition to his present duties as Director of the Geological Survey. Mr. Walcott is well acquainted with the administration of the National Museum. For the past twelve years he has held the position of Honorary Curator in the Museum and for

eight years had his laboratory as paleontologist of the Geological Survey in the Museum building. The interests of the Museum and of the Geological Survey are very closely connected. Mr. Walcott's selection for this post seems an eminently fitting one in view of the unusual executive abilities which he has shown himself to possess since he assumed the Directorship of the Geological Survey in 1894. Mr. Walcott is a native of New York State and has been connected with the Geological Survey since 1879.

IT is reported in *The British Medical Journal* that the sum received by the Huxley Memorial Committee now amounts to nearly £3,000. Mr. Onslow Ford, R. A., has nearly completed the full-size model of the statue which is to be placed in the central hall of the Museum of Natural History at South Kensington. The dies for the Royal College of Science medal are now being prepared by Mr. L. Bowcher.

THE funeral ceremonies of du Bois-Reymond took place on December 29th in the lecture hall of the physiological laboratory, Berlin. Dr. Bosse, the Prussian Minister of Education, represented the government, and there were delegates from many scientific and learned societies. The Reverend Professor Scholz made the chief address; and other speeches were made by Professors Warburg, Munk, Rosenthal, Fritsch and Pictet.

WE regret to notice the deaths of Dr. Aug. Streng, professor of mineralogy at the University of Giessen; of Professor Saccardo, of the Analino School of Viticulture, Italy, and of Frederic John Mouat, who had made contributions to medical and statistical science.

THE following further corresponding members have been elected to the St. Petersburg Academy: Sophus Lie, professor of mathematics in Leipzig; W. Ostwald, professor of chemistry in Leipzig; M. Landolt, professor of chemistry in Berlin; Karl Zittel, professor of paleontology in Munich.

PROFESSOR PAUL HARZER, director of the observatory near Gotha, Saxony, has been appointed director of the observatory at Kiel and professor of astronomy in the University in the place of the late Professor Krüger.

PROFESSOR VIRCHOW has been reelected President of the Berlin Medical Society.

LEOPOLD VOSS, of Hamburg, announces as in preparation von Helmholtz's *Vorlesungen über theoretische Physik*, edited by Arthur König, Otto Krigar-Menzel and Carl Runge, to be published in six volumes.

FRANCIS P. HARPER will publish the journals of Alexander Henry the younger and David Thompson, the former a fur trader and the latter a geographer, edited by Dr. Elliott Coues.

SECRETARY MORTON, in his recent report, calls attention to the inadequacy of the salaries paid to higher officials in the Department of Agriculture. The salary of a chief is now $2,500, and that of an assistant $1,800. The Secretary has recommended, in the estimates for the next fiscal year, that the salaries of chiefs of divisions be increased to $3,000 and those of assistant chiefs to $2,000. He calls attention to the fact that on account of the low salaries paid for scientific and skilled services, the Department is constantly losing some of its ablest and best workers. The universities, colleges, and experiment stations, paying better salaries and offering equal opportunities for useful work and the acquirement of national reputation, are frequently taking the best men. Thirty-two leading scientific experts have left the Department during the last few years to take positions in other institutions, at a rate of remuneration averaging fully 50 per cent. more than they received from the government of the United States.

THE reports regarding the bequest of Alfred Nobel have been meager and conflicting. The London *Times* and other journals stated that the fourth prize was for a compilation in physiology or medicine, but the foreign journals now state that this prize is for a work of literary art. The prizes in physics and chemistry will be awarded by the Academy of Sciences of Sweden; the one for work in physiology or medicine by the Carolus Institute of Stockholm; the literary prize by the Swedish Academy, and the one for the furtherance of peace by a committee of five members chosen by the Norwegian Storthing.

WE have published an account of the report of the Committee of the British Asso-

ciation for the Advancement of Science on the establishment of a national physical laboratory. It is reported that the Council of the Association will take steps to bring the matter before the government, and to invite the cooperation of the Royal Society of London, the Royal Society of Edinburgh, the Royal Astronomical Society, the Physical Society, and other cognate associations, in securing the foundation of the laboratory.

MR. C. G. PRINGLE, says the *Botanical Gazette*, has returned from his annual trip to the more unknown regions of Mexico with 20,000 specimens.

DR. DAHL, says *Die Natur*, has sent from Ralum, in the Bismarck Archipelago, a collection made from the fauna and flora of that little-known region to the Museum in Berlin.

THERE is, it appears, in San Francisco, an incorporated Atlantic and Pacific Aerial Navigation Co., which proposes to build a large airship and has, at all events, purchased from the Pittsburg Reduction Company a quantity of aluminium.

Prometheus, in the issues of January, 1897, is publishing illustrated articles on German industries (*Die Heimstätten der modernen Industrie*), which have considerable interest to our own manufacturers, especially in departments in which exportation is a matter of actual or potential importance.

THE estimates of the Russian Minister of Finance include about 64,500,000 roubles for the construction of the Siberian Railway and over 33,500,000 roubles for the construction of other railways. It also appears from the statement of the Minister that the manufactured products of Russia greatly exceed in value those of agriculture.

ACCORDING to the official report issued on January 28th, there have been 4,396 cases of the plague in Bombay, and 3,275 deaths from that disease. At Kurrachee 694 cases and 644 deaths have been recorded. At Poonah there have been 65 cases and 60 deaths, and a few cases have occurred at Surat, Baroda, Ahmadabad, Kathiawar and Cutch.

ACCORDING to *Industries* the trials of H. M. S. 'Terrible' has resulted in proving her to be the fastest cruiser afloat. Admirable as were the trials of the 'Powerful,' those of the 'Terrible' are even more satisfactory, a mean speed of no less than 22.41 knots being obtained under very adverse circumstances, the sea being rough and the wind having a velocity of 26 miles an hour, with an indicated horse-power of 25,572. With an indicated horse-power of 25,069 a speed of 22.24 knots was obtained against the wind; with the wind the 23 knots of the course was accomplished in just over the hour, the actual figures obtained being 22.873 knots. The coal consumption, with partially untrained stokers, was 1.71 lb. per indicated horse-power per hour.

THE leading article in the current number of *Appleton's Popular Science Monthly* is entitled 'Herbert Spencer, the Man and his Work,' and is by Professor W. H. Hudson, of Stanford University, who was at one time closely associated with Mr. Spencer in his work. Dr. E. L. Youmans and the *Popular Science Monthly* accomplished much to establish Mr. Spencer's reputation, and it is fitting that the completion of the system of Synthetic Philosophy, should be signalized by the publication of this article. The series of articles by Professor W. R. Newbold concludes with one on the interpretation of automatism, and Professor W. Z. Ripley begins a series of articles on the Racial Geography of Europe, which were delivered as Lowell Institute lectures, in 1892. In the first article the relation of language to race and nationality is especially considered. There are also articles by the late Horatio Hale on Indian Wampum Belts; on Some Primitive Californians, by Mary Sheldon Barnes; on How Plants and Animals Spend the Winter, by W. S. Blatchley, and Condemnation of Criminals not Punishment, by Edward F. Brush. There are biographical sketches of W. D. Gunning and Maria Mitchell, both with portraits

ACCORDING to the present law scientific books and periodicals devoted to scientific research are admitted free of duty. The New York *Medical Record* states that the Treasury Department has recently issued a circular to the Collectors of Customs in which it is said that certain books have been admitted under a too

liberal construction of the law, and the customs officers are notified that the words 'scientific books and periodicals devoted to original scientific research' relate to new discoveries in the field of science, and do not include text-books, compilations, and discussions of scientific subjects already understood. It is still uncertain how much original matter will entitle a book to free entry as one 'devoted to original research,' but a case which has come up recently in Philadelphia concerning the importation of a medical work has been appealed to the Circuit Court and may bring about a settlement of the question.

UNIVERSITY AND EDUCATIONAL NEWS.

THE annual report of the Provost of the University of Pennsylvania, with the appended documents, makes a volume extending to 248 pages. It covers, however, a period of more than two years, from June 9, 1894, when Mr. Harrison assumed the duties of acting Provost, to September 1, 1896. This will probably always be regarded as one of the most important periods in the history of the University. The preceding Provost, Dr. Pepper, had used his great energy and abilities to expand the University in every direction. Mr. Harrison has placed the external and internal affairs of the university on a firm basis. He has supplemented his own executive ability by a Vice-Provost, Professor Fullerton, whose knowledge of educational matters has greatly aided the reorganization of the University. This work has extended to every school and department, the standards having been raised throughout and the correlations improved. The chief losses to the scientific departments have been the death of Professor J. A. Ryder, and the resignations of Dr. John S. Billings and Dr. Harrison Allen; the chief gains have been the appointments of Professor C. A. Doolittle, in astronomy; Professor E. G. Conklin, in comparative embryology, and Professor A. C. Abbott, in hygiene. Of advances in the University the next noteworthy has been the gift of $500,000 by the Provost for the encouragement of liberal studies and the advancement of knowledge. Of nearly equal importance has been the erection of dormitories, and of Houston Hall, an admirable club house for students. In the scientific departments attention should be called especially to the work of the Wistar Institute and of the department of archæology and paleontology, and to the establishment of the Flower Astronomical Observatory and the Botanic Garden.

GENERAL J. WATTS DE PEYSTER will erect for Franklin and Marshall College, Lancaster, Pa., a library building with a capacity for 75,000 volumes.

PRESIDENT GILMAN, of John Hopkins University, has accepted the presidency of the Baltimore School Board.

FRANCIS E. LLOYD, professor of biology in the Pacific University, Forest Grove, Oregon, has been appointed professor of biological science in the Teachers' College, New York.

DR. ALEXANDER P. ANDERSON has been appointed professor of botany at Clemson College, S. C.

DR. JAMES WARD, fellow and one of the tutors of Trinity College, Cambridge, has been appointed to the newly established chair of mental philosophy and logic. The new University statutes passed in 1881 provided that professorships should be established in physiology, in pathology and in mental philosophy and logic as soon as sufficient funds could be provided from the common University fund and other sources. Accordingly a professor in ph siology was appointed in 1883 and a professor in pathology in 1884. Owing to the decrease in the college revenues, the common University fund was found insufficient to justify the annual charge of £700, the stipend of the professor of mental philosophy and logic. As we have already reported that the chair was at last established by the Senate on December 10th with the assistance of a subscription from Professor Sidgwick.

PROFESSOR ALFRED HUGHES has resigned the chair of anatomy in the University College, Cardiff. He has granted to the College the free use of his anatomical collections, on which he has spent large sums of money and many years of labor. In the event of his wishing to remove these at some future period, he has placed at the disposal of the College a sum of money sufficient to replace them.

Dr. von Buchka has been appointed the successor of Dr. Eugen Zell in the Imperial Board of Health, Berlin, and has qualified himself as privat-docent in the University of Berlin. The subject of his inaugural lecture being 'The scientific basis of the newer development of analytic chemistry.'

DISCUSSION AND CORRESPONDENCE.

NOMENCLATURE OF METAMORPHIC LAVAS.

In the gold belt of the Sierra Nevada there are two very distinct sets of lavas. One of these is Juratrias in age or older, and is separated by a marked unconformity from a later set of lavas, chiefly of Tertiary age. The older set of lavas has been metamorphosed in varying degrees, so that at some points their original nature is not evident. Even where little altered they almost universally contain secondary minerals, such as epidote, zoisite, chlorite, uralite and calcite. The general appearance of these rocks and their mineral composition is, therefore, very different from the correspondng set of Tertiary lavas.

It is, therefore, very confusing to the general public to use the same set of names for the two sets of rocks. In the gold-belt region the older series of lavas has been compressed and infolded with the Juratrias and older sediments, which are called the auriferous slate series, since they contain by far the larger portion of the gold-quartz veins of the Sierra Nevada.

In many other parts of the world there are similar broad distinctions to be made between an older and younger set of lavas. It is very important that some method should be devised by which one may designate the fact that any given lava originally corresponded to a given type and at the same time express the fact that it has undergone metamorphism. This has been done in specific cases in various parts of the world. Thus Dr. Bascom, with the rhyolites expresses by the prefix *apo-* the fact that the rock, originally a glassy rhyolite, has undergone devitrification. The prefix *epi-* has also been used in some cases to express alteration. Thus the rocks called the epidiorite have been shown in many cases to have resulted from the alteration of diabase. The term metadiorite was used by Dana, and lately has been used by Cross and the writer, for diorites formed by the alteration of other rocks, without reference to their original character. None of these terms has thus far been used in a general way to express alteration in all of the altered lavas.

Dr. Bascom writes concerning the three prefixes that have been mentioned, as follows:*

"The prepositions *meta*, *epi* and *apo*, as prefixes, all indicate some sort of an alteration. Their exact force has been thus defined by Professor Gildersleeve: '*Meta* indicates change of any sort, the nature of the change not specified.' This accords with the use of the prefix by Dana in such terms as 'metadiorite' and 'metadiabase.' These terms have been recently revived to designate rocks 'now similar in mineralogical composition and structure to certain igneous rocks, but derived by metamorphism from something else.' *Epi* signifies the production of one mineral *out of* and *upon* another. This prefix has not been much used. We find it in such terms as epidiorite, epigenetic hornblende and epistilbite. *Apo* may properly be used to indicate the derivation of one rock from another by some specific alteration."

It is evident that Professor Gildersleeve's definition, that the prefix *meta* is the most logical one to use to express, in a general way, the metamorphic condition of altered rocks. Probably if the term had not already been used in certain specific senses there would be no objection to its adoption for this purpose, and speaking of meta-andesites instead of porphyrites; of meta-basalts instead of melaphyres, of meta-rhyolites instead of quartz-porphyries, and of meta-trachytes instead of orthophyres. This would express not only at once the fact that the rock was originally an andesite, basalt, rhyolite or trachyte, but also of the fact that it had undergone a metamorphism which would suggest the presence of the various secondary minerals which are almost always found in such altered lavas.

The adoption of this system of nomenclature is urged by the writer as a means of simplifying the very burdensome and unphilosophical series of names in use at the present time.

H. W. Turner.
U. S. Geological Survey,
January, 1897.

* Journal of Geology, Vol. I., p. 827.

THE LAW OF SIZE-WEIGHT SUGGESTION.

IN 1893 Dr. J. Allen Gilbert, working under my direction, obtained measurements on the size-weight illusion. A cylindrical block of 82 mm. diameter and of 55 g. weight was compared with a series of blocks of 35 mm. diameter but of various weights. The subject first lifted the large block, and then picked out, by lifting, that block of the series which appeared to be equal in weight to the larger one. The error in weight thus made was due to the suggestive effect of the difference in size.

These were the first measurements made on the size-weight illusion ('Studies from the Yale Psychological Laboratory,' 1894, II., 43).*

The problem was then investigated in detail by Dr. C. E. Seashore ('Studies from the Yale Psychological Laboratory,' 1895, III., 1). Two sets of cylindrical blocks were made. Set *A* varied in diameter, but had a uniform weight of 80 grams. Set *B* varied in weight, but were of a uniform size of 43 mm. The subject, lifting the block between thumb and finger, was requested to select for each block in *A* a block of equal weight in *B*. In this way the effect of size on apparent weight was determined.

In the 'Studies' for 1894 I had already pointed out the possibility of establishing the law of suggestion in such experiments. I now find it possible to do so on the basis of Dr. Seashore's work.

The curve conforms closely to the form $y = \frac{k}{x}$ which is the equation of a hyperbola referred to its asymptotes as axes with the constant k depending on the nature of the experiment. The actual measurements differ from the values required for this formula only by a small quantity $z = f(x)$, which expresses the apparent increase in the diameter of the block due to the contrast with the constant length.*

If the blocks of the *B* series be made of the constant diameter c and those of the *A* series of the constant weight d, and if we denote by s the difference in size acting as a suggestion, by i the resulting illusion and by k a constant depending on the nature of the experiment, then we have the general law

$$i = \frac{k}{s + c} - d,$$

which can be called the law of size-weight suggestion. Thus, in the first set of experiments c was 43 mm., d was 80 g., and k was determined by the facts: that the blocks were looked at while lifted; that the subjects were ignorant of the illusion, etc. In the other sets of experiments by Dr. Seashore k took other values.

E. W. SCRIPTURE.

YALE UNIVERSITY,
January 1, 1897.

* Professor Binet has called attention to the fact that he anticipated Gilbert by one month in measuring suggestion by his experiments on the length of lines. This, however, was quite a different form of suggestion. If the question is to be raised as to the first measurements of suggestion in any form, I am justified in claiming priority over Binet by the experiments briefly indicated in the *Educational Review*, 1893, V., 61.

* The exact values of z have not yet been determined experimentally. The results of a special investigation will appear in the 'Studies from the Yale Psychological Laboratory.'

SCIENTIFIC LITERATURE.

Round the Year: A Series of Short Nature-Studies. PROFESSOR L. C. MIALL, F. R. S. Pp. 290. Macmillan & Co. Price, $1.50.

The book is precisely what its title promises. Its author is a cultivated and observant scholar who loves nature and records her various phases after the manner of the old-time naturalist, though rectified by new-time science. It reminds one of White's Natural History of Selborne, and the author's familiarity with that classic has unconsciously led him into the amiable and homelike style of White, and this is to the merit of the book. He evidently has little sympathy for much that goes for modern natural history to-day. He says "natural history is being choked by unassimilated facts mechanically compiled by men who have apparently ceased to think about Nature. Hence a profuse and growing literature of the most melancholy description, dry, marrowless, useless. We record and record till our catalogues grow too voluminous for storage and too stodgy for the toughest appetite." The subjects discussed cover a wide range; we are led from Insects

and Plants in Mid-winter to Snow Flakes, Birds in Mid-winter, Animals with and without Combs, The Moon, the Oil Beetle, Buds, Dutch-weed, Flower-Haunting Insects and twenty-seven other equally diversified subjects. It is interesting to learn that "Jenner, the discoverer of vaccination, was accomplished in music, and studied natural history with diligence and success." He it was who made most valuable contributions on the habits of the cuckoo, the hibernation of the Hedge-Hog, and other subjects.

A curious mistatement is made on p. 53, where the author speaks of the pearl-forming Avicula as the shell which the Chinese utilize in making artificial pearl images. Any local shell collector would have told him that it was Hyria, a fresh water mussel, and not the marine Avicula, which the Chinese use for this purpose.

The illustrations are well chosen and clearly drawn. For teachers of elementary science and as a reading book for the higher grammar and even High Schools it may well be commended. E. S. Morse.

Researches on Mimicry on the basis of a Natural Classification of the Papilionidæ. By Dr. Erich Haase; translated by C. M. Child, Ph. D. 1896. Pp. 154, plates 8, colored, 4to. Nägele, Stuttgart.

It should interest entomologists, and general zoologists also, to know that an English translation of a part of Dr. Erich Haase's elaborate study of mimicry among the Papilionidæ has been published. The results of Dr. Haase's researches were originally published in two parts in Leuckart and Chun's Bibliotheca Zoologica.

The portion issued in English translation is Part II. of the study, and makes a quarto volume of one hundred and fifty pages with eight colored plates. The translator, Dr. C. M. Child, now of the University of Chicago, undertook his work at the suggestion of Dr. Leuckart, of the University of Leipzig, and has made a conscientious and idiomatic translation of this important contribution to the knowledge of mimicry. Dr. Child, though not a professed special student of insects, is known to entomologists through his excellent study of Johnston's antennal organ of hearing.

So much of our knowledge of mimicry has come through the study of the mimetic phenomena exhibited among insects, and especially among the butterflies, that it was to be expected that the first serious attempt to combine a study of phylogeny with a study of mimicry should have butterflies for its subject. Systematists have certainly not yet taken much into account the influence of mimicry in making forms of wide phyletic divergence superficially alike, or in making closely related forms superficially dissimilar. Yet mimicry produces exactly these conditions; and where so many members of a group, as Dr. Haase shows is true of the butterflies, owe the chief features of their habitus to the influence of mimicry, systematists have got to take this matter into account. And this will be good for us, for it will hold up very plainly to us one of the most interesting and instructive phases of the biological study of organisms. It may broaden some of us; it can narrow no one of us.

As much for its suggestiveness as for its light on the origin and development of mimetic coloration among the butterflies, entomologists should become acquainted with Dr. Haase's work. Vernon L. Kellogg.

Stanford University,
California.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

The February number opens with an article by C. E. Beecher, giving an 'outline of a natural classification of the trilobites.' This is the opening portion of a memoir which will be completed in the numbers immediately following. The author's extended study of this group has enabled him to reach definite conclusions, not only in regard to the position that the trilobites properly occupy as a group of the Crustacea, but also to give a systematic and minute classification of the families and genera. The subject is too special to allow of being developed here, but attention may be called to the plate in which certain typical forms are taken to show the principles adopted as the basis of classification.

Carl Barus describes a form of interferential induction balance and details some experiments to show what may be accomplished with it. This apparatus involves the principles of Michelson's interferential refractor, the iron cores of two like helices at right angles to each other being fastened at one end and free to move in the direction of the axes at the other. The interference fringes are visible whenever the excursions of the free ends of the cores are either zero or vibrating in the same phase, amplitude and period to and from the point of convergence; for other phases the fringes vanish more or less fully. In the course of one series of experiments to test the speed of transmission of electric impulses from one helix to another, the author concludes that an arrangement could be made which would indicate the retardation along something over a single knot of wire of high capacity inserted between the helices. This retardation would be exhibited by the passage of one yellow interference fringe across the spider lines of the telescope.

John Trowbridge and Theodore M. Richards discuss the multiple spectra of gases, as a continuation of their work on the spectra of argon described in the January number. They have experimented upon the spectra of nitrogen, hydrogen and other substances, with the result of confirming their former conclusion that the electrical conditions of the circuit have an essential influence in determining the character of the spectra obtained.

Theo. Holm gives the third paper of his studies of the Cyperaceæ. This is devoted to a morphological and anatomical study of *Carex Fraseri* and is illustrated by a plate.

T. A. Jaggar, Jr., describes a simple mechanical device for inclining a preparation in the microscope in petrographical study. It allows, for example, of a rapid determination of the optical orientation in feldspar sections and similar cases.

A. E. Verrill has two papers; the first on the nocturnal protective coloration in mammals, birds, fishes and insects as developed by natural selection. In this he calls attention to the fact that the color of many animals is such as to give them protection at night at the time when it is most called for. This is illustrated by a number of interesting examples. The second paper discusses the nocturnal diurnal changes in the color of certain fishes and of the squid (*Loligo*), with notes on their sleeping habits. When at Wood's Holl, Massachusetts, in the laboratory of the United States Fish Commission, in 1885–1887, the author had an opportunity to make observations on the marine animals in the aquaria between midnight and two o'clock a. m. Some remarkable cases of change of color were then noted. It is remarked that most fishes sleep very lightly and are aroused by almost imperceptible vibrations of air or water. Some of the fishes take remarkable attitudes while asleep.

The same author gives additional notes in regard to an enormous octopus, as it was supposed to be, which was thrown up on the Florida coast some weeks since. The body as preserved is some 21 feet long and is estimated to weigh between six and seven tons. The name *Octopus giganteus* is proposed for it.

O. C. Marsh has an article on the Stylinodontia, a sub-order of Eocene Edentates, in which a description is given, with numerous figures, of *Stylinodon mirus*, the type specimen as described in May, 1874. In regard to the origin of the Edentates the author repeats his remarks of August, 1877. He concludes by saying that the work of the past two decades has served to confirm the opinion that this group of mammals originated in North America and migrated from there to other parts of the earth where their remains have been found or living representatives are in existence.

The number closes with the usual chemical, physical and geological abstracts and notices.

AMERICAN GEOLOGIST, JANUARY.

SKETCH of W. W. Martin, accompanied by a list of official and professional positions held by him and a bibliography, by C. H. Hitchcock.

'The study of natural Palimpsests,' by G. P. Grimsley, gives a brief historical account of the discoveries in archæan and metamorphic rocks, and the methods employed in their study.

F. W. Sardeson continues his discussions on the Galena and Maquoketa series begun in the December number. Under the Galena series he recognizes the Beloit and Galena formations,

both of which are further subdivided into beds characterized by certain leading fossils. The Maquoketa series is divided into the Transition, Maquoketa and Wykoff formations, which also comprise beds marked by the presence of certain genera.

Jules Marcou has the first installment of a paper on 'Rules and Misrules in Stratigraphic Classification.' The early history of geologic correlation is sketched, and the independent discoveries of Giraud-Soulavie, William Smith, Cuvier and Brongniart are reviewed. Direct application is then made to American geological correlation, with special reference to the Taconic and Champlain systems.

'The relation of the streams in the neighborborhood of Philadelphia to the Bryn Mawr gravel,' by F. Bascom. With the exception of the large rivers, the streams of this region are shown to be of superimposed origin, having begun on a surface covered with gravel deposits, underlying which were older crystalline and paleozoic rocks. This has made their valleys quite independent of the strike or hardness of the rocks through which they are now cutting. The age of the Bryn Mawr gravels has been uncertain, and they have been referred to the Mesozoic, the Tertiary and the Quaternary by various observers. The author shows that they cannot belong to the Quaternary and inclines to the belief that they are a member of the Potomac formation, though the data obtained from the study of the drainage system may not be sufficiently exact to precisely determine their geologic relations.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, MEETING OF JANUARY 6, 1897.

ABSTRACTS OF PAPERS PRESENTED.

I. MICROSOMES AND THEIR RELATION TO THE CENTROSOME.

THE problem of the centrosome presents itself under five heads:

1. The centrosome in caryokinesis of tissue cells.

2. The centrosome in the maturation of the ovum.

3. The centrosome in fecundation, or, more strictly, *the problem of the origin of the centrosomes which take part in the first caryokinetic division of the fertilized egg-cell.*

4. The centrosome in cells in which locomotor function is more or less well developed, as in leucocytes, pigment-cells, and some unicellular organisms.

5. The centrosome in some cells which undergo periodic growth, as in the sperm-mother-cell, the ovarian ovum, and some tissue cells. The centrosome in some ganglion cells probably belongs to this group of phenomena.

It was pointed out that these are coordinate features of one and the same problem. The different forms of the centrosome and their mode of origin, their variations under pathological conditions, their behavior during fertilization of the ovum in different forms, were examined in reference to two fundamentally opposed theories now current among cytologists.

In this connection a historical review of our knowledge of the microsomes (cytomicrosomes), as found in the observations of Hanstein, Schmitz, Schwartz, Strasburger, van Beneden, Boveri, Heidenhain, together with the author's observations on the ovarian ovum of an ascidian, was presented, and the bearing of the microsome question on the problem of the centrosome, pointing to the existence of homology between microsome and centrosome, was indicated.

The main conclusion of the paper was as follows: The living substance of the cell-body is to be regarded as composed of an element capable of dimorphic existence, with perfect freedom of transition from one to the other, under some definite condition. It can exist in the form of cytomicrosomes, or it can assume the appearance of clear, hyaline filaments, network, or vesicular structure, as the case may be. At one stage, the cell-body of a given cell, say an ovarian ovum of some organism, may be composed almost wholly of microsomes; at the next these microsomes may be transformed into hyaline cytoplasmic substance, with corresponding increase in the bulk of the cell.

In the phenomena of caryokinesis, fecundation, motion, periodic growth of the cell referred to at the beginning of the paper, both of

these cytoplasmic elements arranged in definite ways, come into play, and in the power of more or less rapid transition from one to the other is to be found an explanation of the main features of the phenomena, so far as the share of the cytoplasm, as such, is directly concerned in each process.

The results of these examinations, together with the author's unpublished work on *Ascaris*, in which it was shown that the centrosome in the *Ascaris* egg not only undergoes some periodic changes in its bulk, but totally disappears at a certain stage, were urged against the theory that the centrosome is a permanent organ of the cell.

S. WATASE.

II. CENTROSOME AND ARCHOPLASM.

A SUMMARY of the conclusions reached in my work on the egg of the earthworm (*Allolobophora fœtida*) follows:

1. The attraction spheres, both male and female, are of cytoplasmic origin.

2. The archoplasm is a specific substance, and not a mere thickening of the cytoplasmic network.

3. The microsomes are morphological elements and not merely varicosities of the cytoplasmic threads. They vary greatly in size, and many of them are unmistakably independent of the cytoplasmic reticulum.

4. Five observations were urged as evidence that the archoplasm is a specific substance and of a fluid nature. These observations were: (1) the relatively rapid movement of the substance, (2) the changes in its distribution caused by fixatives, (3) its transparent appearance in the living egg, (4) the cytoplasmic reticulum is not lessened by its aggregations, nor (5) disturbed by its migration.

KATHARINE FOOT.

III. CENTROSOME AND SPHERE IN THE OVARIAN STROMA OF MAMMALS.

THE cells of the ovarian stroma of some mammals (dog, rabbit) appear to undergo a peculiar change during pregnancy. The small, indistinctly defined, elongated or polyhedral cells are no longer seen, but their place is occupied by polyhedral cells of many times their size. The nucleus of these cells is regular in shape and contains numerous clumps of chromatin irregularly distributed. It does not usually lie in the center of the cell, but is displaced more or less toward one side. Around the central region of the cell is observed a distinct condensation of the cytoplasm, which is very conspicuous after double staining. It is not sharply limited from the remainder of the cytoplasm, but shades gradually into it. The whole cytoplasmic network, especially around the denser part of the condensation, shows a more or less distinctly radiate structure, though there are no distinct fibres. This structure can often be traced almost to the periphery of the cell. Within the condensed portion of the cytoplasm, at or very near a point forming the center of the radiate arrangement, lies a small, deeply staining granule or, in some cases, two. This granule is very clearly shown by the use of Heidenhain's iron-hæmatoxylin, after which it differs from all other extra-nuclear structures in the cell in retaining the dark blue or black. This body is undoubtedly a centrosome, and the condensation of cytoplasm around it undoubtedly represents a 'sphere.'

Now these cells are not preparing for mitosis, and, as far as has been found, there is no evidence of any future division. Whether the cells are in process of degeneration and are replaced by new cells after the period of gestation is ended, it has been as yet impossible to ascertain, but it is probable that they are not. Moreover, the steps in the appearance of the centrosome and sphere in these cells have not been observed, so that it is not known just when or how they first become visible. No trace of them has been found, however, in the stroma of ovaries from animals which are not pregnant or have not recently borne young, nor has any evidence of mitosis been seen in the stroma proper. Mitotic figures are occasionally seen in the cells of young corpora lutea. The functions of these structures under these conditions is not clear. The relation of the histological changes in the ovarian stroma to pregnancy also needs further study.

The presence of the centrosome and sphere in cells which are not undergoing mitosis presents a problem which is at present rather ob-

scure. They have been recently found and studied in the cells of the spinal and sympathetic ganglia of the frog (Lenhossék, Dehler), in the neurochord cells of an annelid (Miss Lewis) and in ganglion cells of a snail (McClure). They have also been found in connective tissue cells, pigment cells, resting leucocytes, etc. In the great majority of non-dividing cells, however, they have not been demonstrated.

It would appear, from the observations given above, that the centrosome and sphere may have some other function in the economy of the cell, in addition to their important rôle in the process of caryokinesis. In the case of the ovarian stroma the facts presented appear to favor the view that the centrosome, as such, is not a permanent organ of the cell, but may appear and disappear according to the conditions which prevail in the life of the cell.

C. M. Child.

IV. THE CENTROSOMES IN THE ANNELID EGG.

My observations have been made on the marine annelid *Chætopterus* in the endeavor to throw light on the following open questions:

1. Is there in the egg a definite structure—centrosome—not an artifact, and not identical with the 'centrosphere' or 'astrosphere'?

2. Is the centrosome 'a derivative structure arising by a modification of some pre-existing element in the cell,' or is it 'a permanent and ultimate organ of the cell, an organ *sui generis*, and coexistent with other ultimate organs of the cell, as the nucleus and the cytoplasm'?

3. Do the centrosomes grow, multiply by self-division, and persist from one cell generation to another, or are they formed anew in each cell in anticipation of caryokinesis?

4. What rôle does the centrosome play in fecundation—'its bearing on the phenomena of inheritance'? Is there a union of male and female centrosomes during fecundation similar to that of the male and female pronuclei—a 'quadrille of the centers'?

5. Whence come the centrosomes of the first and succeeding cleavage spindles?

6. What is the relation of the centrosome to the centrosphere (astrosphere)? To the cytoplasmic rays and network? To the Zwischenkörper?

If the eggs are kept in sea water for half an hour or more and not fertilized, all except the smaller ovarian eggs are found to have the first maturation spindle well formed, in its definitive position, and always in the same stage of development, *i. e.*, the metaphase or equatorial-plate stage. But if the eggs are preserved after having remained only a few minutes in sea water they are all, so far as my experience goes, found to contain the germinal vesicle and no spindle. I infer from this that sea water in some way stimulates the egg to the production of maturation spindles.

The smallest ovarian eggs are characterized by their relatively large nuclei and by their compact cytoplasm, which, devoid of yolk, stains a deep purple with our method—iron-alum hæmatoxylin and orange G. I can find in such eggs nothing resembling or indicating a centrosome.

Yolk granules which stain yellow soon begin to accumulate in the cytoplasm and the eggs grow larger. The yolk, however, is not at first distributed uniformly throughout the cytoplasm, but is most abundant near the periphery of the egg and frequently also immediately outside the nucleus. Where the yolk is present one can readily distinguish a cytoplasmic network, in the meshes of which yolk is held. The threads of the network have the appearance of minute granules arranged in linear order. They form a sort of membrane at the periphery of the egg, and are continuous with the nuclear membrane.

But up to the time when the egg has attained about two-thirds its full size there remain masses of cytoplasm containing no yolk and consisting of a network closely compact and staining dark purple. The component threads of these cytoplasmic masses are evident enough, and are continuous with the rest of the cyto-reticulum. These masses I consider to be equivalent to the *nebenkerne* or paranuclei of authors. They vary in shape and number in different eggs and at different stages of development, now appearing as one or two crescentic masses about the nucleus, and now broken up into many pieces. Their fate is always the same; they gradually fray out and become resolved into the general cyto-reticulum.

When the last traces of the paranucleus have vanished the cytoplasm presents a nearly uniform appearance throughout. The reticulum is characterized at this stage by the decidedly granular composition of the fibrils and the circular appearance of the meshes as seen in section, and also by the uniform distribution of yolk throughout the egg.

Although the structure of the reticulum, the peripheral egg membrane (pellicle) and nuclear membrane are beautifully clear and easily demonstrable, there is *as yet no trace of anything suggesting a centrosome.*

Soon after this, as the egg grows larger, the cytoplasmic threads show a tendency to an arrangement in straight lines rather than curves, so that the outlines of the meshes are polygonal rather than circular. Eggs which have reached this stage in development, when placed in sea water, continue to develop as far as the formation of the first maturation spindle. The tendency of the fibrils of the network toward straightening out becomes accentuated, so that many of them extend in straight lines for a distance several times the diameter of the single meshes. Moreover, these longer fibrils radiate from common centres, and in this way there arises in the cytoplasm a number of *miniature asters.* At first only two or three rays may be seen; then they increase in number and length at the direct expense of the remaining network. The aster formation continues until a climax is reached, when one can count no less than *seventy-five distinct asters* scattered about through the cytoplasm in the vicinity of the meshes. (Many of them are half way between nucleus and periphery of the egg.) These asters repel the yolk as do those of the caryokinetic spindle.

The period of development characterized by multiple asters is not of long duration. Two of the asters gain predominance over the others in point of size, and continue to grow larger, while the others gradually evanesce. The two larger asters I will call *primary*, and the others *secondary* asters, following Reinke, who has described a similar aster formation in the peritoneal cells of the larval salamander.

Whether the primary asters are formed directly by an actual union and evanescence of several of the secondary asters, I am not prepared to say at present. Many things indicate that this is the case. At any rate, the two primary asters continue to grow; a minute dark brown sphere, the centrosome, appears in the center of each, itself surrounded by a lighter brown area, astrosphere, or centrosphere, from which the purplish rays diverge in every direction. I am convinced that these two asters and their centrosome are formed by a modification of cytoplasmic structures. They usually *arise at a considerable distance from each other* and from the germinal vesicle, and while the nuclear membrane and the nucleolus are still intact. *They are the asters and centrosomes of the first maturation spindle.*

After the spindle is formed, it remains for a little while near the germinal vesicle. Each centrosome divides into two; the nuclear membrane disappears; the chromosomes and the nucleoli are drawn up to the region of the equator of the spindles, and the whole spindle swings around to its definitive position at the periphery of the egg, and perpendicular to the surface. The light brown astrospheres at the poles of the spindle contain each a pair of centrosomes. The spindle remains in this condition until the egg is fertilized.

I have artificially fertilized the eggs of *Chætopterus* after they had been in sea water an hour and twenty minutes, yet they developed normally. Immediately after the entrance of the sperm the maturation processes are resumed. The first maturation spindle, which has remained up to this time in the equatorial-plate stage, now passes through the succeeding phases of mitosis, which result in the formation of the first polar globule. During these processes the two centrosomes in the aster at the inner pole of the spindle move apart, and a small central spindle is formed between them. The centrosphere fades away and the rays of protoplasm converge to the two centrosomes. The centrosomes at the outer pole of the spindle are carried into the polar globule and there degenerate. A delicate Zwischenkörper is formed at the junction of the polar globule and egg, but it soon vanishes and has nothing to do with the formation of the second maturation spindle. (Compare Mathews, Jour. Morph. X., No. 1, p. 334.) The small spindle before

mentioned becomes the second maturation spindle by means of which the second polar globule is extruded.

The two centrosomes, which, as we have seen, are identical with those in the inner aster of the first maturation spindle, move still further apart and, with spindles between them, take a position on either side of the group of chromosomes left in the egg after the first division. Tho chromosomes are arranged in the equatorial plate, and the whole spindle swings around to an approximately vertical position directly under the first polar globule. The radiations from both ends of this spindle are long and conspicuous. The centrosome at the inner end usually, perhaps always, divides into two. It is surrounded by a small centrosphere.

The second polar globule is formed by the usual process of mitosis. In the second polar globule, as in the first, there can be seen for a time the degenerating centrosome of the outer pole of the spindle. A Zwischenkörper is formed, consisting at first of a circle of small dots, like the middle plate of plants, with rays extending in both directions. Later it becomes constricted to a single center with diverging rays, and in this condition it is distinguishable until the pronuclei have nearly united. The chromosomes left in the egg at the inner end of the spindle group themselves so as nearly to surround the centrosome and its astrosphere. The rays of the latter are numerous and long, extending through half the diameter of the egg.

The nine chromosomes swell up into as many vesicles which migrate toward the middle of the egg, and as they do so unite to form one large female pronucleus. The aster and centrosome are carried along with the vesicles for a certain distance, but degenerate before the vesicles have united. The rays of this aster, which were very strongly developed when the vesicles were first formed, become weaker and weaker, and finally disappear entirely. While they are still present they converge to the center of the group of vesicles and indicate the position of the centrosome.

While the processes of maturation have been going on, the entrance of the sperm has wrought profound changes in other parts of the egg. The sperm may apparently enter the egg anywhere. Soon after it has entered we find near it a minute aster with two centrosomes close together. They lie in a minute astrosphere from which a few short rays diverge.

These two centrosomes are known as the 'male centrosomes,' though in *Cheiopterus* I am not sure that they are actually carried in by the spermatozoön. A strong presumption is created in favor of this view by the fact that the sperm has in the middle piece two bodies resembling centrosomes. However this may be, the male centrosomes separate as the head of the spermatozoön enlarges, to form the male pronucleus, and as they separate, the rays diverging from them become more and more extensive.

Besides moving apart, the centrosomes migrate toward the center of the egg, the male pronucleus accompanying them, sometimes on one side and sometimes on another, but always near at hand. They finally take a definite position a little to one side of the center of the egg and toward the polar globules. The central spindle which has developed between them lies at right angles to the egg axis. At this time nearly all the cytoplasm of the egg appears in the form of varicose fibrils, radiating directly from the two male centrosomes.

These enormous male asters are the poles of the first cleavage spindle. They are already connected by a central spindle. The pronuclei come together between the poles and elongate slightly. The nuclear membrane disappears; the chromosomes arrange themselves in the equatorial plate usually in two distinct groups, and we have the first cleavage spindle in the metaphase.

During the formation of the cleavage spindle a centrosphere develops about each centrosome, and the rays become very much shorter, for their distal portions break up to form again a cytoreticulum.

While the chromosomes are undergoing the longitudinal splitting, each centrosome divides into two in anticipation of the next cleavage. The two daughter centrosomes move apart in each astrosphere without disturbing the spherical shape of the latter, until the beginning of the telaphase, when the chromosomes at either

pole of the spindle commence to swell up into vesicles in preparation for the reconstitution of the nuclei. Then the centrospheres fade away and the centrosomes with the central spindle between them move further apart to opposite sides of the new nucleus. At this stage we find once more the enormous radiation directly from the centrosomes which involves nearly all the cytoplasm in the egg.

When the new nuclei have reached the so-called resting stage the centrospheres develop again, the distal part of the rays break up into the network, the centrosomes divide, and the processes just described are repeated.

With each cleavage a beautiful Zwischenkörper is developed. It consists at first of a circle of small dark bodies staining like the centrosomes, each with a brush of fibrils diverging toward the newly formed nuclei. At a later stage these bodies all become compressed into a single mass and lose their individuality.

The phenomena exhibited in the egg of *Chætopterus* lead me to the following conclusions:

1. That there is in the egg a definite body—the centrosome—which is not an artifact nor a myth, and which is not identical with the centrosphere or astrosphere, though the latter is sometimes present.

2. That in the oocyte of the first order, *i. e.*, the unmaturated egg, the centrosome arises by a modification of pre-existing cytoplasmic structures.

3. That the centrosomes, whatever their origin, are capable of growth and multiplication and persist through at least several cell generations.

4. That there is no union of male and female centrosomes during fecundation—no quadrille of the centers. The female centrosomes, on the contrary, entirely degenerate, and therefore the centrosomes cannot be considered a special means for conveyance of hereditary qualities.

5. The centrosomes of the first and succeeding cleavage spindles are identical with, or derived directly from, the male centrosomes, which are probably brought into the egg with the middle-piece of the spermatozoon.

6. The centrosphere, a differentiated region about the centrosome, gives a different reaction from the centrosomes, on the one hand, and the rest of the cytoplasm on the other, both in point of color and resistance to certain reagents.

Corrosive, acetic and other reagents will sometimes completely destroy the centrosphere, though the rays and other structures are fairly well preserved.

The centrospheres, unlike the centrosomes, come and go with each succeeding caryokinesis. When they are present, the cytoplasmic rays of the aster are less strongly developed then when they have disappeared, and the rays diverge directly from the centrosomes themselves.

The centrosomes divide and move apart within the centrosphere for a considerable distance without altering the shape of the latter.

A. D. MEAD.

V. THE CENTROSOME PROBLEM AND AN EXPERIMENTAL TEST.

IT is now generally supposed that the centrosome represents 'the especial organ of cell division,' 'the dynamic center of the cell.' The outcome of investigation as generally understood is well stated by Dr. Wilson in his recent work on 'The Cell' (p. 171):

"From the father comes the centrosome to organize the machinery of mitotic division by which the egg splits up into the elements of the tissues, and by which each of these elements receives its quota of the common heritage of chromatin. Huxley hit the mark two score years ago, when, in the words that head this chapter, he compared an organism to a web of which the warp is derived from the female and the woof from the male. What has since been gained is the knowledge that this web is to be sought in the chromatic substance of the nuclei, and that the centrosome is the weaver at the loom."

The evidence as to the origin and function of the centrosome is not all in yet, and some of what is in cannot be easily reconciled with these generalizations. How very difficult it is to reach certainty in observations on this structure, no one knows by his own experience better than Dr. Wilson himself. That the centrosome comes from the mother in parthenogenetic eggs is one fact about which no doubt

can be raised. Two cases are now known in which the same thing is claimed for fertilized eggs (*Myzostoma*, *Unio*), and the work of Miss Foot on the egg of *Allolobophora fœtida* suggest that the so-called sperm-aster may not, after all, be a derivative from the sperm. Mead's discovery of numerous asters in the unfertilized egg of *Chætopterus* suggests that these structures and the centrosome as well are but transient figures of the cytoplasmic network—figures that may appear at any number of points of the cell body on occasion. In that case their disappearance would not indicate degeneration, but merely a return to the reticular condition, a resolution of figure rather than of substance. This view would accord with the theory of the centrosome advanced by Dr. Watase.

The question as to which sex determines the pace of development, or whether both sexes share in this determination, is one for which it is possible to find a crucial, experimental test. My experiments are not yet concluded, but they already furnish a decided answer to the main question. The experiments are made by crossing different species of pigeons having different incubation periods. The crosses first made, and the only ones thus far fruitful, were between the common dove ♂ and the ring-dove ♀ (*Turtur risorius*). The incubation period of the male species is from 18 to 20 days, while that of the female species is from 14 to 15 days. If the male furnishes the centrosome we should expect to have the rate of development retarded and the incubation possibly prolonged to the time of his species. In the reverse experiment, with a male *T. risorius* and a female common dove (experiment now in progress), the rate of development would be accelerated, and the time of incubation correspondingly shortened. One pair have hatched young three times, each time in the period of the mother. A second pair (♂ = a fantail) have hatched once, also in the regular time of the mother. The young birds were perfectly formed.

These experiments show that the rate of cell-formation and embryonic development up to the time of hatching is determined by the sex that furnishes the egg. Some marks of paternal derivation are already visible in the newly hatched hybrid, *e. g.*, color of the beak and character of the down. The male influence is most predominantly marked in the later development and color of the plumage.

C. O. Whitman.

BIOLOGICAL SOCIETY OF WASHINGTON, 270TH MEETING, SATURDAY, JANUARY 16.

Theo. Holm showed the Society a botanical work printed in the year 1549, in which binomial nomenclature was in use. This book was Leonhart Fuchs' Historie des Plantes, and it was surprising to see that several of our common plant-names used to-day were also known at that very early date, for instance: *Vitis vinifera*, *Aconitum lycoctonum*, *Angelica silvestris*, *Digitalis purpurea*, etc.

Mr. Holm also showed the first and the last volume of the famous work 'Flora Danica,' which contains illustrations of 3,240 plants from Denmark, Norway, Sleswic, Færœ islands, Iceland and Greenland engraved on copper. This work was begun in the year 1761, the expense being paid by the Danish king until 1883, when the publication was brought to a close. The botanical editors of the work were Oeder, O. F. Mueller, M. and I. Vahl, Hornemann, Drejer, Schouw, Leibmann, Japetus Steenstrup and Lange, while six Danish kings contributed the funds necessary for the publication of this voluminous opus.

Mr. Holm thereupon showed a specimen of the interesting *Draba hyperborea*, which had lately been collected by Mr. Macoun on the Pribilof Islands. This species is not only of gigantic size in proportion to the other species of *Draba*, but it is also most characteristic in having a monopodial ramification. The species of *Draba* are generally annual, biennial or perennial, but have constantly a terminal inflorescence. In *Draba hyperborea*, on the contrary, the bud is terminal, but purely vegetative and lasts for several years, while the inflorescences are all lateral. A similar case was known to the speaker to exist in *Arabis dentata*, which, in this respect, showed a difference from most of, if not all, the other species of *Arabis*.

W. T. Swingle exhibited specimens of two simple algæ from the Gulf of Naples, remarkable for the great size of the apicial cells. Although very similar in appearance, these two

species differed fundamentally in the manner of their growth.

Specimens of two poisonous plants were exhibited by V. K. Chesnut. The first was a new species of Water-Hemlock (*Cicuta vagans* Greene), the rhizome of which is poisoning cattle in Oregon and Washington. The second was the oleander or Laurier Rose (*Nerium oleander* L.). This plant was recently mistaken at Jesus Maria, Chihuahua, Mexico, for the mountain, or rose, laurel (*Kalmia latifolia* L.). An extract was made from the leaves, which was added to honey and fed to some bees at that place. They were not poisoned by it, but the honey deposited by them proved to be very deleterious to two persons who ate from it. The mistake in the identity of the species was revealed by specimens obtained from the experimenter.

Under the title 'Unity or Plurality of Type Specimens in Paleontology,' Mr. David White called attention to the difference of opinion and usage between botanists or zoologists and paleontologists, particularly paleobotanists, respecting the application of the word 'Type,' such differences arising largely from the dispersion of the parts of plants and the conditions of preservation. Owing to the conditions of fossilization, most species of fossil plants are originally based on several specimens, each of which contributes characters not seen in the others. Such are coordinate or 'Co-types.' For specimens, such as fruits, leaves, preserved tissue, etc., serving as the source of additional specific characters, subsequently described or illustrated, the name 'Supplementary Type,' was advocated. Mr. White urged that any paleontological specimen that has furnished new specific characters for incorporation in the diagnosis, or for illustration, is thereby removed from the level of other specimens in the collection, and therefore deserves an appropriate designation, according to circumstances. Preferring for such purpose some qualification of the word 'Type,' he tentatively suggested for certain presented cases the terms 'Subsidiary Type,' 'Continental type,' etc.

Mr. White also exhibited specimens of 'A New Lycopodineous Cone from the Coal Measures of Missouri,' at Clinton, together with its bracts, presented to the National Museum by Dr. J. H. Britts. These illustrated his previous remarks, the former belonging to the genus *Lepidostrobus*, the latter of the genus *Lepidophyllum*.

Mr. Edward L. Greene spoke of the 'Development of the Idea of a Genus,' as shown in the works of the earlier herbalists and botanists.

Mr. M. A. Carleton presented a paper on the 'Ontogenetic Separation of Puccinea graminis Avenæ from P. graminis Tritici.'

The forms of *Puccinia graminis*, or stem rust, on wheat is quite distinct from the one occurring on oats, though until recently they have been considered identical. The distinction is founded mainly upon this behavior in artificial inoculations, though there are probably other reasons for separating them. The form on oats can not be transferred to any other cereal. The form on wheat is readily transferred to barley, and probably occurs on rye, and, with still less certainty, on oats. In inoculation experiments the form *Avenæ* infects 21 species of Graminæ in 18 genera. Similar experiments with the form *Tritici* are not yet completed. Eriksson has obtained like results, as a rule, in Sweden.

F. A. LUCAS, *Secretary*.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, JANUARY 7, 1897.

MR. ASHMEAD exhibited an agamous female of *Belenocnema treatæ* Mayr. The true sexual generation consists of winged males and females issuing from galls on the roots of live oak, while the agamous generation consists of subapterous females issuing from a gall which occurs on the leaves. Mr. Ashmead has connected the two galls simply from a study of structural characters of the adult insects.

Professor J. B. Smith, a corresponding member, gave a brief review of a classification of the orders of insects, as a result of a series of studies made during the past few years. He proposes to divide the true 'Insecta' primarily into two series upon the character of the mouth-parts, making one a suctorial type to contain the orders Thysanura and Rhyngota. All the others are mandibulate in some stage of their existence. These mandibulata he divides into three other series, according to the development of the prothorax. In one case the prothorax is entirely free in the adult, and

this series contains the Dermaptera and Coleoptera, in which the hind wings are transversely folded, and the Plecoptera, Platyptera and Orthoptera, in which the hind wings are longitudinally folded beneath the primaries. The second series is that in which the prothorax is fairly well developed, but is quite closely attached at its base to the other segments, and is not freely movable, as in the case of the first series. In this branch, which was terrestrial from the start, are included the Isoptera, Mallophaga, Corrodentia and Neuroptera. The third series had the prothorax reduced in size from the beginning, and always united to the other thoracic segments, the general tendency being towards a complete loss of function of all save the legs in this part. All the members of this series are from an aquatic form, and they include the Odonata, Ephemerida, Trichoptera, Lepidoptera, Mecoptera, Siphonaptera, Diptera and Hymenoptera. From the Neuroptera, as generally understood, he separates the Sialidæ, which he makes, with its relatives, an order under the term Platyptera.

This paper was actively discussed by Messrs. Banks, Gill and Ashmead, who criticised details rather than the general ideas expressed.

Dr. A. D. Hopkins, a corresponding member of the Society, presented some notes on Scolytidæ, with descriptions of four new species, viz.: *Pityophthorus frontalis*, a species which infests dead oak twigs; *P. fagi*, which infests peach twigs; *Thysanoes querciperda*, infesting oak, and *T. obscurus*, reared from hickory twigs.

L. O. Howard,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 56th meeting of this Society, held in Washington, D. C., January 13, 1897, communications were presesented as follows:

The Measurement of Faults: J. E. Spurr, U. S. Geological Survey. Faults are simple movements in the rocks of the earth's crust along fracture planes, and, since these planes may stand in any attitude, there is no rule by which the nature of a fault may be judged beforehand. The *existence* of a fault can be determined by the evidences of friction along the plane of motion, such as fault breccia, polished and striated rock faces and so on; the amount of movement, however, can be completely ascertained only by the aid of independent and accidental phenomena. In homogenous rock masses the amount of movement cannot be ascertained; in heterogeneous rocks it may ordinarily be ascertained with greater or less accuracy, and the variations in rock masses must be used as criteria. The commonest variations which are constant enough to be reliable as data are sedimentary beds, and hence it is easy to fall into the error of considering faults simply as dislocations of strata. In careful geological work, however, any available criterion must be regarded as of as much value as any other; in mining geology the most valuable are, besides sedimentary beds, igneous bodies (such as dikes), bodies of ore, striæ on the fault plane, showing direction of movement, and the composition of the fault breccia, which may show in some degree, the amount of movement.

In seeking to measure a fault it is necessary to have clearly in mind some of the principal functions of fault movement. Among these functions certain which are of greatest importance are adopted and defined. These are: *Total displacement*, *lateral separation*, *perpendicular separation*, *throw*, *vertical separation* and *offset*. The number may be increased indefinitely, yet ordinarily this is undesirable.

Glaciation of Puget Sound Region: Bailey Willis. During the past season the drift deposits about the southeastern edge of Puget Sound have been studied in some detail. They are found to consist of several beds of till, separated by stratified deposits of clay, sand and coarse gravel, together with widely distributed lignite beds. The character and extent of the glaciation of the Puget Sound region are indicated in these deposits, and it is found that the principal flow of the ice was rather from the north than from the mountains on the southeast. Two problems are presented by the phenomena: (1) the sequence of glacial advance and retreat, and the extent and duration of climatic changes indicated by the presence of lignites; (2) the bearing of the peculiar conditions of glacial development upon the physiography of the sound. Either the deeper valleys of the sound have been eroded during a period of high level from

the once more extensive sheets of drift, or, as suggested by Russell, the channels represent the beds repeatedly occupied by glaciers which, in their advance and retreat, built up the plateau-like eminences of the region, probably upon the divides of the pre-existing topography. The past condition of Puget Sound under confluent glaciation is probably now represented by the Malaspina glacier and its attendant phenomena.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

NEW YORK ACADEMY OF SCIENCES.

THE Geological Section met January 18th, and listened to the papers of which abstracts are given below. Both will appear in full in the Transactions.

The first paper was 'Notes on the Geology of the Bermudas,' by J. J. Stevenson.

After describing the several types of rock deposits and their relations, as well as the surface features of the area, Professor Stevenson offered the following conclusions respecting the successive conditions:

First: The Limestone or 'base rock' of the island was formed by accumulations of dune sand. During a prolonged period of quiet, this rock underwent great erosion, both surface and subterranean; the collapsing of cavern roofs caused great 'sinks,' some of which, no doubt, still exist as such, though to distinguish them from those of later origin would be difficult.

Second: A period of subsidence followed, during which the land sank 120 feet or more; marine deposits encroached upon the land, extending through valleys, thus giving beach rock at widely separated localities and in somewhat anomalous positions.

Third: Succeeding this was a period of quiet, during which the Sandstone was formed, as the Limestone had been, by accumulations of dune sand and the great 'sinks' were filled up, as the basins of Castle harbor are now filling.

Fourth: A period of elevation followed, during which the land must have risen to at least its former level. The old subterranean drainage system must have been re-established in many instances and the former depression cleaned out; while near systems may have been formed, causing new groups of depressions.

Fifth: This was succeeded by a period of subsidence, during which the land sank to very nearly the same position as at the maximum of subsidence in the previous period, the highest marine beds being now only a few feet above the water's edge. The more important bodies of water began in the deeper depressions early in this period, but they assumed their present forms, due to shore erosion, only in the later portion, when the subsidence was very slow and evidently interrupted more than once by prolonged periods of quiet.

The paper was well illustrated by the lantern.

The second paper was 'The Geological Section at Cliffwood, N. J.' by Arthur Hollick.

Mr. Hollick described the Cretaceous clay marl in the vicinity of Cliffwood, New Jersey, one of the localities where the fauna of the horizon has been collected and the only one at which any fossil plants have been found.

The strata in question are the equivalent of the Matawan formation of Professor W. B. Clark, which represents the transition from the plastic clays of the Raritan formation below to the greensand marl above, and, as may be expected, shows a commingling of fresh-water, land and marine conditions. The specimens collected consist of crustaceans, leaves, fruit and twigs of trees and masses of lignite. The crustaceans are too fragmentary for exact determination. About 15 species of mollusks were identified and 26 species of plants, the majority of the latter belonging to the Coniferæ. Of these, nine are here described as new species. The paper was illustrated by maps of the region, by drawings of the specimens and by the specimens themselves.

J. F. KEMP,
Secretary.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

BY invitation the New York Section of the American Chemical Society held an informal dinner at the Knickerbocker Athletic Club, Friday evening, January 8th, after which the regular monthly meeting was convened in one of the assembly rooms of the club, about fifty-five members being present.

The chair was taken by Dr. McMurtrie at 8.15, and, after routine business had been disposed of, the reading of papers was then taken up as follows:

'Note on an Improved Specific Gravity Bottle for Liquids,' by Dr. E. R. Squibb; 'Note on the Determination of Caffeine,' by G. L. Spencer; 'Variations in the Composition of Commercial Red Lead,' by Durand Woodman; 'The Methods for Determination of Tannin,' by J. H. Yocum; 'Modern Metallurgy of Copper,' by J. B. F. Herreshoff.

Mr. Spencer reviewed the precautions necessary in the determination of caffeine by both Gromberg's and the gravimetric method, and concludes that the Gromberg method gives the most satisfactory results, and admits of wider application than the gravimetric method, particularly as by the latter it is difficult to obtain absolutely pure caffeine.

Dr. Woodman gave the results of a series of factory tests on commercial red leads, taking the position that the litharge removed by digestion in solution of lead acetate is simply that portion which has escaped oxidation, and is therefore a diluent merely, and a measure of the incompleteness and imperfection of the roasting process. He finds no uniformity in the amounts of the uncombined or free litharge, either in the samples which are the subject of his paper or as reported by other analysts. According to his determinations the following variations are shown:

	1	5	B.W.L.	64	C.	L.B.	B.W.L.	L.B.
Red lead...	51.0	41.0	60.0	28.0	58.0	90.0	73.5	87.5
Free litharge...	49.0	59.0	40.0	72.0	42.0	10.0	26.5	12.5

For present purposes the few per cent. of impurities were not determined, and are included, some in the red lead figures, and others in the litharge.

Mr. J. B. F. Herreshoff made an address on 'Modern Metallurgy of Copper,' reviewing briefly the historical side of the development of the copper industry in this country and pointing out the remarkable increase in its consumption, due to the advance in the applications of electricity. While the iron industry of this country is always spoken of as so enormous, and is indeed of great magnitude, it is only known to those who follow the subject very closely that the production of copper amounts to over one-half of the value of pig iron annually produced.

In 1895 the United States consumed 62.6 per cent. of its production, but in 1896 the home consumption was only about 37.5 per cent., 62.5 per cent. being exported. In the same time there was also a large increase in production.

Mr. Yocum reviewed the methods (and difficulties inherent in them) of determining tannin in barks and extracts. He considers a complete extraction of tannin at low temperatures as an impossibility, regardless of the amount of water used.

Durand Woodman,
Secretary.

The Academy of Science of St. Louis.

At the meeting of the Academy of Science of St. Louis on the evening of January 18, 1897, Professor H. S. Pritchett presented some results of observations on the recent sun-spots, prefacing his remarks by a general account of our present knowledge of the constitution of the surface of the sun, and of sun-spots in general, and illustrating his remarks by the use of lantern slides.

Two persons were elected to active membership.

Wm. Trelease,
Recording Secretary.

NEW BOOKS.

Problems and Questions in Physics. Charles P. Matthews and John Shearer. New York and London, The Macmillan Company. Pp. vii+247. $1.60.

The Mechanics of Pumping Machinery. Julius Weisbach and Gustav Herrman. Authorized translation from the second German Edition by Karl P. Dahlstrom. London and New York, The Macmillan Company. 1897. Pp. 300.

The Story of Extinct Civilizations. Robert E. Anderson. New York, D. Appleton & Company. Pp. 213.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, FEBRUARY 12, 1897.

CONTENTS:

Some Present Possibilities in the Analysis of Iron and Steel: C. B. DUDLEY.....241
Toronto Meeting of the British Association: A. B. MACALLUM.....251
Geology at the British Association: W. W. WATTS..252
Relations of Tarsius to the Lemurs and Apes: CHARLES EARLE.....258
The Primary Segmentation of the Brain: C. F. W. MCCLURE.....260
Charles E. Bendire: C. HART MERRIAM.....261
Current Notes on Physiography:—
Northwestern Oregon; Glacial Deposits of Indiana; Scientific Geography of Italy; Notes on Ashanti: W. M. DAVIS.....263
Current Notes on Meteorology:—
Cloud Heights; Fog Possibilities; International Balloon Meteorology: R. DEC. WARD.....264
Current Notes on Anthropology:—
The Shell Gorgets of North America; The Red Race of Madagascar; Glacial Man in Ohio: D. G. BRINTON.....265
Notes on Inorganic Chemistry: J. L. H.....266
Scientific Notes and News:—
A Director of Scientific Work for the Department of Agriculture; Young's 'Reversing Layer;' Motor Carriages; General.....267
University and Educational News.....274
Discussion and Correspondence:—
'Compliment or Plagiarism?' BEMAN AND SMITH. *Professor Jastrow's Test on Diversity of Opinion:* J. H. HYSLOP.....275
Scientific Literature:—
Higher Mathematics: ALEXANDER ZIWET. *Venable on the Development of the Periodic Law, Mason's Notes on Quantitative Analysis, Cairns' Manual of Quantitative Chemical Analysis:* W. A. N.....277
Scientific Journals:—
The Auk; The Journal of Geology: H. F. B.....281
Societies and Academies:—
The New York Academy of Sciences—Subsection of Anthropology and Psychology: LIVINGSTON FARRAND. *Torrey Botanical Club:* EDWARD S. BURGESS.....283
New Books.....284

*SOME PRESENT POSSIBILITIES IN THE ANALYSIS OF IRON AND STEEL.**

To the analytical chemist there are few substances in nature more interesting than a piece of pig iron, few substances which have received more study, and few which present chemical problems more difficult of solution. The amount of work which has already been done in connection with this very common but very complex substance is something enormous. Indeed, if we add to the study which has already been put on pig iron itself the work which has been done on what may perhaps fairly be called its progenitors, *viz.*, the ores, the fuel, the flux and the refractory materials used in its production, and then consider still further the labor already expended in the analysis of what we may call the progeny of pig iron, *viz.*, castings, wrought iron, malleable iron and the numerous grades and kinds of steel, made by the various processes of the present day, we shall surely be safe in saying that more chemical work has been done in connection with pig iron than with any other substance in nature. Is it too much to affirm that at the present time one-third, possibly one-half, of all the chemical work done in the world is in connection with the iron industry, either in the solution of unworked-out problems, the

* Presidential address delivered at the Troy meeting of the American Chemical Society, December 29, 1896.

development of new methods of analysis, or in the routine analyses affecting the interests of producer and consumer.

But the amount of work already done and in daily progress in connection with this substance is not all that may be said in regard to it. The complexity of pig iron is very great, and consequently the analytical problems presented are far from being easy of solution. It may not be uninteresting to enumerate some of the substances which have already been found in pig iron. We find, besides the element iron, carbon, phosphorus, silicon, sulphur, manganese, copper, chromium, tungsten, titanium, vanadium, nickel, cobalt, aluminum, potassium, sodium, magnesium, calcium and lithium. It is fair to say that there is apparently well grounded belief that the last five are characteristic of intermingled slag, rather than of the metal itself. It is not intended that it should be understood that all of these substances have been found in any one sample of pig iron, but that all these substances have actually been detected in the analysis of this alloy. Indeed, there seems no reason why any element which either occurs in the metallic condition in nature or which is reducible to that condition by carbon, and which is not volatile at the temperature of the blast furnace, may not occur in pig iron, provided, of course, it will alloy with the metal. Quite a large number of other substances besides those mentioned above have actually been alloyed with some form of iron or steel. Among these may be mentioned zinc, tin, lead, antimony, bismuth, molybdenum, silver, platinum, rhodium, irridium, palladium and gold. Nor is this all that may confront the analyst who devotes himself to the chemistry of iron and steel. Not less than three elements which usually exist in nature in the gaseous form occur in these metals, and are believed to have important influences on their physical properties. These are oxygen, hydrogen and nitrogen; while the numerous analyses show that the presence of carbon monoxide in both cast iron, wrought iron and steel. It seems quite evident that the chemist who hopes to cope successfully with the problems which are involved in even the ultimate analysis of iron and steel in their various forms must be well equipped with a liberal share of the methods and processes known to mineral chemistry, and, on the other hand, if he attempt the proximate analysis of these substances, or the separation and determination of the various compounds of the elements present, with iron or with each other, he will, at least, be brought on the border ground of organic chemistry. Some of the carbon compounds which are characteristic of the brilliant work of the present President of the French Chemical Society are known to occur in or have already been isolated from pig-iron.

It would lead us too far from our present purpose to do anything more than enumerate the largest number of the elements given above. Suffice it to say that in what follows we shall confine ourselves to the five first mentioned; *viz.*, carbon, phosphorus, silicon, sulphur and manganese. And the question which we shall ask ourselves is, 'What is the present condition of a portion of the analytical methods for the determination of these substances, considering these methods both in regard to their accuracy and speed?' One word of precaution. It would be manifestly impossible to comment on all the methods in use for determining these constituents. To enumerate them alone would weary your patience. We shall confine ourselves, therefore, principally to methods which may be or are used when the diverse interests of producer and consumer are involved.

Beginning, then, with total carbon in pig iron, wrought iron and steel, we deem it safe to say that the method by combustion

in oxygen gas, as at present known and worked in many laboratories, leaves very little to be desired, so far as accuracy is concerned, and is sufficiently rapid for most commercial uses. The modification introduced some years ago, of using a solution of the double chloride of copper and ammonium, instead of simple chloride of copper,* to release the carbon from the iron, took away from the combustion method one of its greatest difficulties; *viz.*, the long time required to dissolve the metal. The modification, as many will doubtless remember, reduced the time required for solution, from two or three days to an hour or less. Indeed, at the present time, if a good stirring machine is used, it is quite possible to dissolve three grams of fairly fine borings of pig iron, wrought iron or steel, in 200 cc. of the proper solvent in from ten to forty minutes.

Still further the studies of the Committee of International Standards for the Analysis of Iron and Steel have further modified the method, and it is believed rendered it much more accurate. Among these modifications may be mentioned the use of an acid instead of a neutral or basic solution of the double salt to dissolve the metal This point was thoroughly worked out by Blair.† Following this came the work done in the laboratory of the Pennsylvania Railroad Company,‡ demonstrating the unreliability of the use of the double chloride of copper and ammonia as a solvent, owing, as appeared later, to the probable presence in all ammonia and its salts, obtainable in the market, even those marked 'C. P.', of some carbonaceous material, possibly pyridine, derived from the gas liquor used in making the ammonia.

The substitution of the potassium* for the ammonium salt has apparently completely overcome this difficulty, and this with the use of oxygen gas instead of lead chromate, in which to burn the carbon, and some modifications of the absorbing and purifying train, have seemingly placed the dry combustion method for determining carbon in the front rank of successful and accurate analytical processes. The principal known source of error in the method at the present time appears to be in connection with the weighing. The potash bulbs and small calcium chloride tube used in absorbing the carbon dioxide weigh, altogether, some fifty to sixty grams, and present considerable surface. If now, between the weighing before the combustion and the weighing after the combustion, the interval being an hour, or a little more, there is considerable change in the hygroscopic condition of the atmosphere, an error of 0.01 per cent. may be easily introduced. If we may trust our experience, it is difficult to make closely agreeing duplicate combustions in showery weather. Blair suggests a method of overcoming this difficulty, consisting in having a second potash bulb and chloride of calcium tube of, as near as possible, the same size on the opposite end of the balance when weighing.

In regard to the accuracy of the method as at present understood, it may be said that, undoubtedly, the best test of the accuracy of a method is the recovery of a known amount of any substance added to the material to be analyzed. This procedure

* It is difficult to say positively who first suggested this modification. The first mention in literature that we are able to find is in the *Transactions of the American Institute of Mining Engineers*, 4, 157, by J. B. Pearse. But a private communication from Andrew S. McCreath states that he made the suggestion while working under Pearse, and that Professor Richter, in the Leoben Jahrbuch, had previously suggested the use of potassium or sodium chloride with copper chloride, which led him to try the ammonium salt. McCreath's description of the method as used by himself is published in the *Transactions of the American Institute of Mining Engineers*, 5, 575.

†*Trans. Am. Inst. Mining Eng.*, 19, 614.

‡*Trans. Am. Inst. Mining Eng.*, 20, 242.

**J. Am. Chem. Soc.*, 15, 448.

being manifestly impossible in the case of iron and steel, we are compelled to judge of the accuracy of the combustion method, as applied to these metals, in some other way. For this purpose, however, we have at hand the results obtained by different chemists, using different methods, but working on the same samples. In the course of the work done by the Committee on International Standards for the Analysis of Iron and Steel, the carbon in four samples of steel was determined: First, by using acid double chloride of copper and potassium as solvent and burning in oxygen gas; Second, by using the same solvent and burning in chromic acid solution; and Third, by treating the borings direct with bisulphate of potash and heat, conducting the carbon monoxide and sulphur dioxide formed over hot solid chromic acid, which oxidized both gases and retained the sulphur trioxide formed, and finally measuring the volumes of the resulting carbon dioxide in an eudiometer tube. Each method was used by a different chemist. The results obtained are as follows: the letters at the side representing the four samples of steel, the figures at the top representing the chemists, and the figures in the columns the percentages of carbon in the steel samples:

	1.	2.	3.
A	1.455*	1.440*	1.450†
B	0.815	0.800	0.815
C	0.450	0.450	0.448
D	0.152	0.185	0.168

The agreement of the results on the first three samples is quite marked. The discrepancy on the fourth sample has not been explained. The matter is discussed in considerable detail in reference 1, but we think it safe to conclude that, so far as method goes, the determination of total carbon in pig or cast iron, wrought iron and steel, is reasonably accurate.

**Proc Eng of Western Penna.*; 9 [9], 35.
†*Ztschr. anorg. Chem.*, 4 [3], und [4], 505.

The speed of the combustion method as at present worked in good laboratories is quite remarkable, compared with the possibilities twenty-five years ago. A sufficient supply of sample borings being at hand, one operator using two furnaces may readily make from fourteen to sixteen combustions in a day of eight hours, it being understood that the bulbs are weighed with oxygen gas in them instead of air, and that the last weight of each combustion, except the last one at night, is taken as the first weight of the succeeding one. It is, of course, assumed that, when turning out the amount of work above described, the furnaces and apparatus are all in good order, and everything working well. Accidents, an occasional overhauling of the apparatus, blank combustions from time to time for testing purposes, and once in a while an obstinate steel that refuses to dissolve in time or gives trouble in filtration, will all tend to diminish output. The results obtained with this rapid work show, when duplicates are made, occasional discrepancies as high as three hundredths of a per cent. in a steel containing one per cent. of carbon, but we have seen very large numbers of duplicates, made as above described, which did not disagree one one-hundredth.

Again, when work is not so plentiful as to admit of the procedure described above, the method still permits satisfactory speed. Starting with a fresh sample of borings and everything in good order, but cold, it is not difficult to get two closely agreeing determinations on the same sample in two hours and a half. Of course, in investigation or referee work more time would, undoubtedly, be used, especially if the interests involved are very great. But we have many times been astonished, in our own laboratory, at the close agreement between the results obtained in the rapid manner described above, and the duplicate analysis made on the same sample for confirmatory

purposes, but using much more time and pains.

Turning now to the determination of combined carbon and graphite, we do not find the state of affairs so satisfactory. As is well known, these two constituents are usually found by first determining total carbon, then dissolving another portion of the sample in hydrochloric acid, filtering and washing with caustic potash, alcohol and ether, and then burning the residue, collecting and weighing the carbon dioxide formed, as in an ordinary combustion. The result is called graphite, and the combined carbon is the difference between the total carbon and the graphite. But as Shimer* has so well shown, what we actually get by this procedure is not necessarily the graphite and the total combined carbon in the sample, but only the combined carbon which exists in the metal as a carbide soluble in hydrochloric acid. If the sample contains carbides not soluble in that acid, nor in the materials used in washing, the carbon of these carbides appears with and is counted as graphite. Shimer shows that titanium, and possibly vanadium carbide, are apparently not infrequently thus counted. The use of sulphuric instead of hydrochloric acid leads to the same error, while the employment of nitric acid as solvent apparently gives the graphite much more definitely, but leaves us in doubt as to whether the combined carbon is really the combined carbon which we want, in order to have light on the quality of the metal we are dealing with. It is obvious that the difficulty here is in our lack of knowledge as to what carbides actually exist in pig and cast iron, and, if there are several of them, which one or ones do we actually want to know the carbon content of. If we knew positively that the combined carbon wanted was that which exists in the metal as carbides of iron and manganese, and that these carbides were soluble in hydrochlorie or sulphuric acid, while all other carbides present were not soluble in these acids, obviously we should use these acids when determining combined carbon. On the other hand, if we want to know only graphite, and care little about the combined carbon, apparently nitric acid is the solvent to use. It is clear that much more work is needed on this subject, a state of affairs which, as we progress, we shall find is characteristic of other constituents of the metals we are considering.

* *Trans. Am. Inst. Min. Eng.*, 25, 395.

Much might be said in regard to the color test for determining carbon in steel. It is difficult to over-estimate the value and importance of this method, especially in the daily operation of steel works, and there seems little doubt but that, if proper precautions are employed, the method, in skillful hands, will give results that are fairly reliable to within three or four hundreths of a per cent. It would hardly be possible in this paper to discuss all the precautions which are deemed essential by those best informed. A chemist of wide experience with the method has enumerated twenty-four points that must be observed if reliable results are to be expected. Let it suffice for us to say that even approximate accuracy cannot be expected:

1. If the steel whose carbon is to be determined and the standard steel do not have their carbon in the same condition. For example, if the standard steel has been annealed, and the sample to be tested has been tempered, the results will be worthless.

2. If the attempt is made to determine the carbon in any steel by using a standard widely different from it in carbon content. Using a 0.20 per cent. carbon standard, with a steel containing 0.50 or 0.60 per cent., is apt to lead to very fallacious results.

The best results seem to be obtained by having the carbon in all steels, both standards and tests, in the condition given by annealing, by having a number of standards which differ little from each other in carbon content, and by not attempting to use the method on steels containing very little or very large amounts of carbon. It may not be amiss to add here that the practice, so prevalent in many of the steel works, of using this method for all carbon determinations, including those where contracts are involved, is reprehensible and should be discontinued. The chemist at the works does the best he can with the method he is using, and the amount of work required of him, as well as the facilities furnished, do not admit of the use of a better method. On the other hand, when a dispute arises, and it is ultimately shown that the works are in error, the chemist is blamed and analytical chemistry brought into disrepute, not because either is really at fault, but because more is expected of the color test method than it is really able to give. To the steel makers we say, "Do not expect your chemist to render you the bricks of good chemical analyses, unless you give him the requisite straw of time and appliances to do good chemical work."

Few of the constituents of iron and steel have more important influences on their valuable qualties than phosphorus, and upon few has more chemical work been done. The present condition of the methods for determining this constituent seems fairly satisfactory, provided we are willing to take time enough to do the work. In confirmation of this statement, the work* done by the Sub-committee on Methods of the International Committee on Standards for the Analysis of Iron and Steel may be cited. This sub-committee consisted of five members, each of whom analyzed five samples of steel, and each used his own method, without any attempt at consultation or agreement with each other before the work was done. The methods employed may be briefly indicated as follows, those interested being referred to the report of the committee published as per the reference given for the details. Mr. Blair used what is known as the acetate method. Mr. Shimer used the molybdate-magnesia method. Your speaker used a combination of the acetate and molybdate-magnesia method. Dr. Drown used a combination of certain features of the modern rapid methods of the molybdate-magnesia method. And Mr. Barba on one sample used the acetate method as described by Blair, and on the other four samples employed certain features of the molybdate method to separate the phosphorous from the iron, and then used the reductor to get the amount of phosphorus, instead of weighing as magnesium pyrophosphate. It will be evident, to any one carefully reading the report referred to, that the methods employed differed widely in principle, in strength of solutions and in manipulation, and yet these methods gave the following percentages of phosphorus in the five samples:

	1.	2.	3.	4.	5.
Mr. W. P. Barba,	0.041	0.015	0.095	0.091	0.041
Mr. A. A. Blair,	0.040	0.016	0.098	0.091	0.041
Dr. T. M. Drown,	0.042	0.016	0.104	0.090	0.042
Dr. C. B. Dudley,	0.040	0.016	0.099	0.097	0.039
Mr. P. W. Shimer,	0.041	0.017	0.098	0.096	0.039

In explanation of the results, we quote from the report of the sub-committee:

"Sample No. 1 is an ordinary open-hearth steel. Sample No. 2 is a crucible steel. Sample No. 3 is an open-hearth steel to which metallic arsenic was added while in the molten condition in a crucible. Sample No. 4 is an ordinary Bessemer rail steel. Sample No. 5 is the No. 5 sample of the Committee on International Standards, and is an open-hearth steel.

"It will be observed that the agreement in the results on phosphorus obtained by

Proc. Am. Soc. Civil Eng., 21, 59.

the different chemists is very good. The exceptions are the No. 3 steel, which contains arsenic in considerable amount, and where the discrepancy is 0.009 per cent., and in the No. 4 steel, where the discrepancy is 0.007 per cent. Considerable work was done on the No. 4 sample, in an effort to reconcile discrepancies, and it was found that the turnings from this sample were irregular, and that two different bottles of the sample gave different results. The average of six determinations from one bottle was 0.1057, and the average of five determinations from another bottle was 0.0964 per cent. Furthermore, siftings from quite an amount of the turnings gave 0.140 per cent."

But these methods are long and laborious. It would be impossible with the most rapid of them to get a result in much less than a day, while two days would certainly be required for some of the others. Accordingly, since the demand for rapid phosphorus determinations during the last ten or fifteen years has been very great, an enormous amount of work has been done in trying to meet this demand. Modification after modification has been introduced, and paper after paper published on the subject. It is, perhaps, not too much to say that few chemical journals that publish any original work at all have escaped three or four articles per year, on the determination of phosphorus in iron and steel, or on some phase of a rapid method for such determination. The result of all this work has apparently been constantly increased rapidity, with constantly greater approximations to accuracy. The present state of the matter is, perhaps, best shown by Thackray* in his paper, 'A Comparison of Recent Phosphorus Determinations in Steel.' This writer sent to some twenty-three different chemists borings from two different samples of steel, with a request to have the phosphorus determined in each sample, and a description of the method used sent with the results. Each chemist was told that samples had been sent to others, but no attempt was made to have any special method used. The chemists embraced a professor in a technical school, the chemist of a large consumer, a number of commercial chemists, and a number of chemists employed by steel and iron works. On one sample thirty-six different results were sent in, and on the other thirty-eight. Twenty-seven different methods were employed, some of the chemists sending in results by two and even three methods, and some sending duplicate determinations. The results obtained were obtained as follows, the figures being percentages of phosphorus in the steels:

Sample.	1.	2.
Average of all determinations	0.0496	0.0685
Highest result	0.055	0.091
Lowest result	0.045	0.076
Maximum difference	0.010	0.015

The methods employed may be divided on the basis of time required into three classes:

1st. Those which may be called rapid, and which give a result in two hours or less.

2d. Those which may be called slow, and which require considerably more than two hours, but still give a result the same day.

3d. Those which may be called very slow, and which do not give a result until the second day or later.

Thirteen results on each sample were given by 'rapid' methods, eleven on the No. 1 sample and twelve on the No. 2 sample by 'slow' methods, and twelve on the No. 1 and thirteen on the No. 2 by 'very slow' methods. Arranging the results in accordance with this classification of the methods, we have some very interesting data, the figures being as before, the percentages of phosphorus in the two steels:

* *Trans. Am. Inst. Min. Eng.*, 25, 370.

	R. method.		S. method.		V'y S. Method	
	1.	2.	1.	2.	1.	2.
Average of all determinations	0.0499	0.0840	0.0490	0.0826	0.0496	0.0837
Highest result	0.054	0.091	0.052	0.086	0.055	0.089
Lowest result	0.045	0.078	0.046	0.076	0.046	0.078
Maximum difference	0.009	0.013	0.006	0.010	0.009	0.011

To our minds these figures are very impressive. It is worthy of note:

1st. That the average results given by the 'rapid' methods only differ on either steel from the averages given by the 'slow' or 'very slow' methods, by a little over 0.001 of a per cent.

2d. That the maximum difference between the highest and lowest results given by the 'rapid' methods on either steel is but a trifle greater than is shown by the 'slow' or 'very slow' methods.

In other words, if we interpret these results correctly they show that the rapid methods for determining phosphorus in steel now known and used in many laboratories give results that are well-nigh as accurate and reliable as those yielded by the longer and more laborious methods, and it must not be forgotten that, although we have placed two hours as the time characterizing a rapid method, a number of the results given above were obtained by the use of methods which give a single determination in forty-five minutes, and enable one operator to make twenty phosphorus determinations in a day. We are free to say we do not believe such a showing would have been possible five years ago.

But these results still leave something to be desired. The discrepancy between the highest and the lowest result is still too great. It is, perhaps, a little hazardous to place limits, but we do not think the chemists of the country should be satisfied until they are in possession of a method or methods which are so carefully worked out and so well described that in the hands of different chemists of fair ability and experience results will be obtained by all, when working on the same steel, that will not differ from each other more than 0.003 per cent. The Sub-Committee on Methods of the International Committee on Standards for the Analysis of Iron and Steel, before referred to, have had in hand, now for some two years, studies on a rapid and accurate method for the determination of phosphorus in steel. It has been the hope of the Sub-Committee that the ideal above given would be attainable by this method. In reality, the work of the Sub-Committee has embraced an examination of almost every chemical point involved, taking very little, if anything, for granted, and checking and proving every step. The work is not yet quite ready for publication, one or two points remaining which are not entirely settled, and it has been deemed advisable to withhold the method until these are completely cleared up.

Some years ago, with the publication* of what is commonly known as Ford's method, the determination of manganese took a decided step forward, at least in this country, so far as speed is concerned. Previous to that time the long and laborious acetate method, which involved the separation of the iron from the manganese as basic acetate and subsequent precipitation of the manganese by means of bromine or as pyrophosphate, had held full sway. Ford's contribution consisted, as is well known, in separating the manganese from hot nitric acid solution of the iron or steel, by means of potassium chlorate, and Williams† added the modification, now in common use, of determining the separated oxide of manganese, by its action on a standard solution of ferrous sulphate or oxalic acid. This method, as now worked in many laboratories, gives a single result in forty minutes and two in an hour, and enables one operator to turn out twenty to twenty-five deter-

* *Trans. Am. Inst. Mining Eng.*, 9, 397.

† *Trans. Am. Inst. Mining Eng.*, 10, 100.

minations in a day. The accuracy of this method has been questioned. We are not aware of any recent symposium on manganese where different chemists using different methods have worked on the same steels. In our hands this method gives results closely agreeing with check work done by the more laborious and generally accepted accurate methods, provided the sample contains not more than three-fourths of a per cent. On samples containing over one per cent. of manganese the results are apt to be low, owing probably to the fact that the manganese does not separate from the nitric acid solution as manganese dioxide, but as some other oxide whose composition is not positively known. In the calculation it is customary to regard the separated oxide as manganese dioxide, and this leads to perceptible error on large amounts. Producers and consumers rarely contend much over manganese in steel, and methods for its determination have, perhaps, not received, on that account, all the attention they deserve. There is evident need of more work on this subject.

The methods for the determination of silicon can hardly be regarded as in a perfectly satisfactory condition. If evaporation to dryness, to render silica insoluble, is employed, the time required is considerable. If dehydration by means of sulphuric acid and heat, as suggested by Drown,* is employed, there are difficulties which interfere somewhat with accuracy. There seems little doubt but that in skilled hands, with sufficient care taken in the manipulation, a couple of determinations may be made on the same sample, using Drown's method, that will agree closely with each other and with results given by the longer and more laborious methods. On the other hand, where one operator is making a number of determinations at the same time there is much danger of error due either to failure to dehydrate sufficiently or to over-heating resulting in the formation of insoluble iron salts. Our experience indicates that the margin between these two extremes is not very wide, and that it is fully as frequent to have duplicates on the same sample disagree as to agree. Our observations point to the view that the difficulty of insufficient dehydration is due to the separation of iron salts as the sulphuric acid concentrates. These salts enclose gelatinous silica and prevent the dehydrating acid from getting at it. Unless great pains are taken, therefore, to secure this contact by sufficient stirring, the results will be low. If, by some modification, the iron salts could be kept in solution until the silica is rendered quite insoluble it would apparently be a decided step forward with this method. It may not be amiss here to call attention to the fact first noticed in the laboratory of the Pennsylvania Railroad Company,* that after the dehydration and subsequent dilution are finished, if an interval of a few hours is allowed to elapse before filtration, the silica will redissolve and the results be low. Apparently, as we are able to work the method, the silica is not completely dehydrated, but only sufficiently so that, if filtered at once, fairly accurate results will be obtained.

It is difficult to say anything positive about the speed and output of Drown's method. It is probably safe to say that a couple of determinations could be made in an hour and a half, but, on account of the difficulty mentioned above, the method does not lend itself well to working on a large number of samples at once, and consequently a large daily output is somewhat interfered with.

It must also be said of the methods for the determination of sulphur in iron and

* *Trans. Am. Inst. Min. Eng.*, 7, 346.

* Address to the members of the Chemical Section of the Engineers' Society, at Pittsburg, September 27, 1892, by C. B. Dudley, on 'Discrepancy in Chemical Work by Different Workers.'

steel that those most in use are hardly as satisfactory as could be desired. The studies of Phillips* conclusively show that when using the evolution method the whole of the sulphur content is not given off in such a form as to be retained by the usual means employed to catch the gas. It seems not too much not to say that it is hazardous to use the evolution method on pig or cast iron, even when fusion of the residue is employed.

The formation of unoxidizable gases containing sulphur in the application of the evolution method to steel has not, so far as our knowledge goes, yet been demonstrated, and accordingly the evolution method is still used largely on steels. But on pig and cast irons the oxidation method seems the only one applicable, and some recent studies of Blair, described in a paper at this meeting, indicate that on certain pig irons all the sulphur is not given even by this method, unless the graphitic residue is fused with sodium carbonate and niter. Both methods are somewhat slow, and there is need of further study. If some means could be found by which barium sulphate could be readily and accurately converted into sulphide, so that a volumetric method could be applied to this sulphide, it would be a decided step forward. The necessity in accurate work for purifying barium sulphate, as first obtained from almost any solution, by fusion and reprecipitation, adds quite considerably to the time required. With steels and two sets of evolution apparatus, using bromine for oxidation, two determinations may be made in two hours. With four sets of evolution apparatus one operator can make twelve determinations in a day. In these cases purification by fusion is not attempted. By the oxidation method on pig or cast iron two determinations require about five hours, while one operator, with a supply of borings ahead and sufficient appliances, can get from ten to twelve results in a day. With this output purification by fusion is not attempted. If this is done, the time for a pair of determinations must be extended an hour and a half, and the daily output would be cut down at least a third.

From what has preceded in this hasty and necessarily imperfect survey of a portion only of the analytical methods in use in the iron and steel industry, it is clearly evident that there still remains an enormous amount of work to be done in connection with methods. We have touched upon only five of the fifteen or twenty constituents occurring in and affecting the quality of iron and steel, and find the methods for determining even these more or less imperfect and needing more work. What will be our condition as chemists if, as seems probable, nickel, chromium, aluminum, tungsten, and the gases, oxygen, hydrogen and nitrogen, either free or combined, within the next few years, come into prominence as constituents of iron and steel, and are made elements in important commercial contracts? Still further thus far our methods are concerned almost entirely with the total content of the various constituents we are determining. We know very little about the compounds of the various constituents occurring in iron and steel, with the metal or with each other. Is the phosphorus present as phosphide or phosphate, or both? How besides as sulphide does the sulphur occur? Do the various carbides which are revealed by the microscope, and which are believed to be so closely dependent on the heat treatment which steel receives, and which are so intimately related to the value of the metal, differ from each other in carbon content, or only in crystalline form? Who will be the first to isolate any of these carbides? Who will first give us a practicable, accurate and

* *The Journal of the American Chemical Society*, 17, 891.

sufficiently rapid method for determining oxides in steel? Who will first completely investigate the relation between the chemistry and the chilling properties of cast iron? And who will first give us a study on the form in which nitrogen occurs in this metal, and a sufficiently rapid and accurate method for its determination? Truly the harvest of chemical work before us in connection with iron and steel is bounteous. Will the laborers be forthcoming to gather the harvest?

C. B. DUDLEY.

ALTOONA, PA.

TORONTO MEETING OF THE BRITISH ASSOCIATION.

THE local preparations for the meeting of the British Association for the Advancement of Science to be held this year in Toronto, commencing Wednesday, August 18th, have now after a year's work on the part of the various local committees reached a very advanced stage. The finance committee have been promised $27,500 to meet the expenses of the occasion. The sectional meetings are to take place in the buildings of the University of Toronto, which are centrally situated and which may be reached from all points of the city by means of the electric car system. As the University grounds are adjacent to the Queen's park and in the residential portion of the city, this arrangement will thus be a most agreeable one for the visitors. The Presidential addresses and the evening lectures will be delivered in Massey Hall, which has been recently erected and is capable of holding about four thousand auditors.

Perhaps the most difficult of all the arrangements have been those pertaining to the matter of steamship and railway rates, but in these also very satisfactory progress may be reported. The British visitors will have reduced rates by the Canadian lines from Liverpool. The Canadian railways have made very important reductions to members of the Association who will travel in Canada between July 1st and September 30th. The Canadian Pacific Railway will give special rates also to members who wish to visit the Northwest, British Columbia and the Pacific coast. A large number of special excursions have been organized, some of them to take place during the meeting, others immediately after its close. They will last from two days to three weeks, and as the weather will be cool, no doubt these trips will be exceedingly pleasant for the members.

The retiring President is Lord Lister, President of the Royal Society. The President-elect is Sir John Evans, K. C. B., Treasurer of the Royal Society, who will deliver the Presidential address on the evening of the opening day. The Council of the Association have chosen Presidents for the majority of the Sections. Those already appointed are: Mathematics and Physics, Professor A. R. Forsyth, M. A. D. Sc., F. R. S.; Chemistry, Professor William Ramsay, Ph. D., F. R. S.; Geology, G. M. Dawson, LL. D., F. R. S.; Zoology, Professor Louis C. Miall, F. L. S., F. R. S.; Economic Science and Statistics, Professor E. C. K. Gonner, M. A., F. S. S.; Anthropology, Professor Sir William Turner, LL. D., D. C. L., F. R. S.; Physiology, Professor Michael Foster, LL. D., Sec. R. S.; Botany, Professor H. Marshall Ward, D. Sc., F. R. S. Professor James Dewar, LL. D., F. R. S., and Mr. J. Milne, F. R. S. (late professor in the Imperial University of Tokyo) have been appointed to deliver the evening lectures.

Amongst those who have promised to attend are Lord Kelvin, Lord Lister, Sir Henry Roscoe, F. R. S.; Sir Robert Ball, Professors Viriamu Jones, LL. D., F. R. S.; G. Carey Foster, F. R. S.; J. S. Burdon-Sanderson, LL. D., F. R. S.; A. W. Rücker,

Sec. R. S., J. R. Green, F. R. S.; F. O. Bower, F. R. S.; A. C. Haddon, D. Sc., C.; S. Sherrington, F. R. S.; A. H. Miers, F. R. S.; W. A. Herdman, F. R. S.; S. P. Thompson, F. R. S.; S. H. Vines, F. R. S.; A. G. Vernon Harcourt, F. R. S.; C. Le-Neve Foster, F. R. S.; Mr. J. Scott Keltie, W. H. Preece, F. R. S.; W. H. Gaskell, F. R. S.

It is the intention of the Local Secretaries to issue invitations to a large number of representative foreign men of science to attend the meeting, and it is hoped that a number of these will accept. The presence of foreign scientific men has been a special feature of many of the meetings in recent years, and this has greatly increased the interest of the members and public in the Association, while it has given the latter a semi-international character. The Local Committee desire that the Toronto meeting shall be largely an international one, and they have welcomed the provision made by the Council of the Association whereby the fellows and the members of the American Association are given for 1897 the same standing as old members of the British Association, that is, they will on joining be required to pay $5 only, instead of $10, the amount exacted for new members. The officers of the American Association also have been made Honorary Members of the British Association. The presence of these and the attendence of from forty to fifty Continental (European) men of science will doubtless do much to realize the hopes of those who advocate the formation of an International Association for the Advancement of Science. In any case it will serve to widen the sympathies of the scientific men of the British Empire and of the Anglo-Saxon Republic. The local committee on the other hand will endeavor to make the meeting an extremely pleasant one for all the visitors.

The provisional program of the daily agenda of the meeting will be published in SCIENCE in a few weeks.

A. B. MACALLUM.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE address of the President, Mr. J. E. Marr, was an eloquent and powerful appeal for the systematic pursuit of minute stratigraphical investigation. While petrology may be largely claimed by the Germans, paleontology by the French, and physical geology by the Americans, detailed stratigraphy has been much followed in Britain from the days of William Smith to the time of its present exponents, amongst whom we reckon Lapworth, Buckman, and, he might have added, himself.

Apart from the accurate unravelling of physical structure and the consequent correct knowledge of earth history which thus becomes possible, the President referred to a number of almost unforeseen results, which could only have been obtained when the succession of strata was studied in minute detail and the minor divisions of the rocks laid down on maps of sufficient scale. The detection of small faults and their relation to physical features and to denudation, the identity of ancient rocks and modern deposits, the history of coral reefs, the origin of coal seams, the geography of former periods, the distribution of ancient climates, the direction and nature of earth movement and its effect on the position and structure of igneous rocks, even the history of the crystalline schists —all these branches had received or might be expected to receive help from this line of enquiry. Dealing with the more immediate bearing of stratigraphical research on earth history and evolution and the phylogeny of organisms, he referred especially to the work of Barrande, Walcott, and Matthew on trilobites, of Lapworth on graptolities, of Beecher on

brachiopods, and of Jackson on echinids and lamellibranchs. In conclusion he appealed for a consideration of evolutionary geology against both catastrophism and uniformitarianism.

Sir W. Dawson's paper on 'Pre-Cambrian Fossils,' was of so much interest that we give his own abstract in full; the paper was illustrated by a very beautiful series of lantern slides.

The author stated that it was his object merely to introduce the specimens he proposed to exhibit, by a few remarks rendered necessary by the present confusion in the classification of pre-Cambrian rocks. He would take those of Canada and Newfoundland as at present best known, and locally connected with the specimens in question.

He referred first to the 'Olenellus Zone,' and its equivalent in New Brunswick, the 'Protolenus Fauna' of Matthew, as at present constituting the base of the Cambrian and terminating downward in barren sandstone. This Lower Cambrian had in North America, according to Walcott, afforded 165 species, including all the leading types of the marine invertebrates.

Below the Olenellus Zone, Matthew had found in New Brunswick a thick series of red and greenish slates, with conglomerate at the base. It has afforded no Trilobites, but contains a few fossils referable with some doubt to Worms, Mollusks, Ostracods, Brachiopods, Cytideans and Protozoa. It is regarded as equivalent to the Signal Hill and Random Sound Series of Murray and Howley in Newfoundland, and to the Kewenian, and the Chuar and Colorado Canyon Series of Walcott in the West. The latter contains laminated forms apparently similar to *Cryptozoon* of the Cambrian and *Archæozoon* of the Upper Laurentian.

The Etcheminian rests unconformably on the Huronian, a system for the most part of coarse clastic rocks with some igneous beds, but including slates, iron ores and limestones, which contain worm-burrows, sponge-spicules, and laminated forms comparable with *Cryptozoon* and *Eozoon*. The Huronian, first defined by Logan and Murray in the Georgian Bay of Lake Huron, has been recognized in many other localities, both in the west and east of Canada and the United States; but has been designated by many other local names, and has been by some writers included, with the Etcheminian and sometimes with part of the Laurentian, in the scarcely defined 'Algonkian' group of the United States Geological Survey.

Below the Huronian is the Upper Laurentian or Grenville system, consisting of gneisses and schists (some of which, as Adams has shown, have the chemical composition of Palæozoic slates), along with iron ore, graphite and apatite, and great bands of limestone, the whole evidently representing a long period of marine deposition, in an ocean whose bed was broken up and in part elevated before the production of the littoral clastics of the Huronian age. It is in one of the limestones of this system that, along with other possible fossils, the forms known as *Eozoon Canadense* have been found. The author did not propose to describe these remains, but merely to exhibit some microphotographs and slices illustrating their structure, referring to previous publications for details as to their characters and mode of occurrence.

Below the Grenvillian is the great thickness of Orthoclase gneiss of various textures, and alternating with bands of hornblende schist, constituting the Ottawa gneiss or Lower Laurentian of the Geological Survey. No limestones or indications of fossil remains have yet been found in this fundamental gneiss, which may be a truly primitive rock produced by aqueo-igneous or 'crenitic' action, before the commencement of regular sedimentation.

The author proposed, with Matthew, to regard the Etcheminian series and its equivalents as Pre-Cambrian, but still Paleozoic; and, as suggested by himself many years ago, to classify the Huronian and Grenvillian as *Eozoic*, leaving the term Archæan to be applied to the Lower Laurentian gneiss, until it also shall have afforded some indications of the presence of life.

He insisted on the duty of paleontologists to give more attention to the Pre-Cambrian rocks, in the hope of discovering connecting links with the Cambrian, and of finding the oceanic members of the Huronian, and less metamorphosed equivalents of the Upper Laurentian, and so of reaching backward to the actual beginning of life on our planet, should this prove to be attainable.

An extremely interesting paper by Dr. Matthew dealing with a kindred subject and entitled 'Some Features of the early Cambrian Faunas.'

The paper referred chiefly to the larval features of the early Cambrian Trilobites, because in them we may look for points of structure which will appear in the adult condition of their predecessors. But allusion was also made to the early Cambrian Brachiopoda and Ostracoda.

Trilobites.—Except in *Olenellus* and its allies the larval forms of the earliest trilobites are little known, but in those of the *Paradoxides* beds a number of series of the larval forms are known belonging to different genera, so that in these we have fuller data for comparison.

Cambrian time has been called the 'Age of Trilobites,' and their abundance and variety is truly remarkable. The flexibility of the type is indicated by the numerous genera that appeared successively in that early age. They thus become valuable in marking the divisions of the Cambrian rocks as the vertebrates do those of the Tertiary.

The utility of their remains is manifest in the ease and certainty with which different parts of the Cambrian System can be recognized in all the regions around the Atlantic Ocean, where rocks of this age have been found. This being the case, it may be profitable to examine the forms of the earliest Cambrian trilobites and note how they compare with the larvæ of those of the *Paradoxides* beds. The law of development would lead us to expect that in the *pre-Paradoxides* faunas of the Cambrian certain features of the larval forms of the trilobites of the *Paradoxides* beds should appear as permanent adult features in their predecessors. Let us see if such is the case.

In 1892 Dr. J. Bergeron summed up the evidence on this point, derivable from the trilobites of the *Paradoxides* and *Olenellus* faunas in his article 'Is the Primordial the most Ancient Fauna?'* He used the studies of Barrande, Walcott, Ford and others for this purpose, and his conclusion was that there must have been a more ancient fauna.

Discoveries of other faunas beside that of *Olenellus* have been made since Bergeron wrote upon this subject, and we may now place his theory against some additional facts which bear upon it.

To make the application clearer some of the characteristics of the earliest larval stages of the trilobites of the *Paradoxides* beds as shown in the young of *Paradoxides*, *Ptychoparia*, *Conocoryphe*, *Microdiscus* and *Agnostus* may be presented. Among them are the following:

1. Predominance of the cephalic over the caudal shield.

2. A long, narrow glabella, with nearly parallel sides. In these early moults the posterior lobes of the axial rachis (which includes the glabella) are short and weak compared with the anterior and especially the first.†

* Revue generale des sciences, Paris, 1892.

† *Paradoxides* is apparently an exception to this rule, but we do not know its earliest stages.

3. The eyes are absent; when they first appear they are near the lateral margin, and in several genera are elongated.

4. There are no movable cheeks; when these first appear they are narrow and marginal.

5. There is no thorax; this region begins with one segment, and in some genera never exceeds the number of 2 or 4. The pleuræ at first are short.

6. The pygidium at first is quite short and of one segment.

Three local faunas, all older than *Paradoxides*, have been made known since Bergeron wrote his paper referred to above. They all show more or less the increasing prevalence of larval features in the trilobites as we go back in time. J. C. Moberg has described a number of species from Sweden (including two species of *Olenellus*) in which some of the above larval characters are shown.

J. F. Pompeckz has just described a *pre-Paradoxides* fauna from Bohemia, in which are a few trilobites that carry larval characters. Thus his *Ptychoparia* is referred to the subgenus *Conocephalites*, probably because it has a long eye-lobe. It is a primitive form with short pleuræ, if we may judge from the short posterior extension of the dorsal suture. His *Solenopleura* also differs from that genus in its long eye-lobe and long glabella, but these also are larval features.* Another species of *Solenopleura*, however, cited by Pompeckz has shorter eye-lobes.

It is the *Protolenus* fauna of the St. John's group (Cambrian), however, which shows most decidedly larval traits in its adult trilobites.

Among these trilobites all (so far as their remains show it) have prolonged eye-lobes, a peculiarity which marks the early *Olenidæ*. Many of them have longitudinal glabellæ, also a larval character. Many have a short posterior extension of the dorsal suture, indicating the primitive feature of short pleuræ. Many have small and weak pygidia; this is inferred from the rarity of this part of the organism in the collections preserved.

Protolenus (typical), which has a general resemblance to *Paradoxides*, differs from it in the absence of a clavate glabella, and the small anterior lobe of this part of the head-shield, but these are characters found in the larval stages of *Paradoxides*.

A genus of this fauna, almost as common as *Protolenus*, is *Ellipsocephalus;* this genus also abounds with Protaspian peculiarities.

Lastly, we may refer to the genus *Micmacca*, which has the following larval features, longitudinal glabella, long eye-lobe and short posterior extension of the dorsal suture. If *Zacanthoides* of the Middle Cambrian were shorn of the long posterior extension of this suture and its long pleuræ it would not differ greatly from *Micmacca*.

In the *Olenellus* fauna also are genera, such as *Olenellus*, *Protypus*, *Avalonia* and *Olenelloides*, which retain marked larval characters.

Brachiopoda.—If we turn our attention to the Brachiopoda we note that they show a special development in the early Cambrian different from that of the *Paradoxides* beds and the later members of the Cambrian System.

The most notable feature is the large percentage of *Obolidæ* (including *Siphonotreta*). The older Cambrian holds, in common with the *Paradoxides* beds, the small shells of *Acrothele*, *Acrotreta* and *Linnarssonia;* but it also has a series of larger forms peculiar to it. Such are *Obolus Botsfordia*, *Trematobolus* and *Siphonotreta* of the *Protolenus* fauna, and *Schizambon* and *Micwitzia* of the *Olenellus* fauna. This great development of oboloid shells is not re-

*In the larval forms of *Ptychoparia* and *Solenopleura* of the *Paradoxides* beds, however, the eye-lobe is short.

peated in most countries until Ordovician time.

Not only are these old Cambrian faunas remarkable for the peculiar types of Brachiopods which they possess, but they are also remarkable for those they lack. A *Lingula* has not been found, though *Lingulella* is a common genus.

The larval growths of Ordovician and Silurian *Lingulæ* carry us back to a form which is oboloid. Thus in *L. quadrata*, *L. Howleyi*, etc., the shell is first circular as in *Obolus*, then oval as in *L. quebecensis*, etc., and finally takes on the sub-quadrate form of the adult shell. But there is a more elementary form of the Brachiopod shell than the circular shell of *Obolus;* this is seen in *Paterina* and the young shell of *Botsfordia*, which is nearly semicircular. Both these shells come from beds which are older than *Paradoxides*.

Ostracoda.—The Ostracoda also gives us definite forms peculiar to the early Cambrian beds. Such are the types represented in *Beyrichonia* and *Hipparicharion;* such also are those with flexible tests represented by *Aluta*. Other Ostracods are present in more varied forms than in the *Paradoxides* beds.

The distinctive features of the animals of the earliest Cambrian faunas may be summed up as follows:

1. The trilobites retain larval characteristics to an unusual degree.

2. The Brachiopods have a large percentage of oboloids.

3. The Ostracoda are plentiful and varied and present some peculiar types.

Another paper which will probably be of considerable interest in America is Dr. H. J. Johnston-Lavis' criticism on the work of Messrs. Weed and Pirsson on the Highwood Mountains. These writers describe Square Butte as a laccolite formed in Cretaceous sandstones and composed of an outer and upper layer of a basic rock that they name *shonkinite*, with a core of syenite. The shonkinite shows a laminated structure parallel to the roof, as was likewise the case with the upper part of the syenite. They consider this variation in the rock to show differentiation by diffusion and separation of the two magmas and that the lamination was due to the isotherms in the cooling mass. Dr. Johnston-Lavis showed that these interpretations were not in accord with the facts; if such differentiation had occurred, the line of junction of the two rocks should be roughly horizontal and not parallel to the roof, and he suggested that the lamination was due to shearing planes. His view was that the shonkinite had been delayed in the volcanic conduit and had been basified by osmotic action between the paste and the limestone or other basic rock-walls. This first filled the laccolite and was followed by the less basic or unaltered syenite from below. The white, dyke-like mass was an insuperable difficulty to the views of Messrs. Weed and Pirsson and only explicable by the theory of the present author.

Sir Archibald Geikie read a very interesting paper in which he recognized that some rocks previously described as volcanic agglomerates in Anglesey were in reality crush rocks, but a great deal of volcanic material had contributed to their original formation. Mr. Greenly also attributed the quartzite lenticles of the same island to a similar action upon beds of grit and sandstone. In a second paper he described the occurrence of Sillimanite-Gneisses in Anglesey. The curious mass of ancient rocks which is half submerged under the Trias of eastern England, at Charnwood Forest, was described in some detail by Mr. Watts, who attributed to it a Pre-Cambrian age. He further pointed out that a landscape at least as old as the Trias was here being gradually exposed to-day by the slow removal of the New Red Sandstone in which it was embeded.

A number of papers on subjects of local interest were read by Mr. Morton, Mr. Mellard Reade, Mr. Beasley and others, on the Trias and its footprints, the boulder clays, submerged forests, and on the advance of the sea upon the coast. Excursions were organized to most of the places mentioned in these papers and a long excursion to the Isle of Man conducted by Mr. Lamplugh and Prof. Boyd Dawkins, the latter of whom read a paper on the geology of the Island in which he described its Ordovician, Carboniferous, Permian, Triassic and Pleistocene deposits, together with the igneous rocks.

Messrs. Howard and Small made a communication on the nodular and felsites and other igneous rocks of Skomer Island, which they had determined to be interbedded lavas, associated with tuffs of Bala or Llandovery age. Mr. Garwood presented a report on the progress of his work on the zoning of the Lower Carboniferous rocks by means of their fossils, in which he showed that considerable progress had been made, but the inquiry was hampered by the variable character of what are at present regarded as species in the brachiopods and other organisms.

Mr. Wethered gave an illustrated lecture on the organisms characteristic of the chief limestones in our scale, and dwelt much on the evidence which tended to prove that oolitic structure was of organic origin.

Prof. Hull proposed a new theory to account for the glacial period. If the West Indian Islands were much upheaved at that period, as appears from Spencer's observations to have been the case, the Gulf Stream would no longer accumulate in the Gulf of Mexico and would in consequence reach the North Atlantic about ten degrees colder than it is at present. The amount of high land in the northern hemisphere at this time would also be a contributing cause.

Mr. Clement Reid gave an account of his excavations at the classic locality of Hoxne, in Suffolk, directed towards ascertaining the age of the Paleolithic implements discovered there. Under the top layer, which has yielded the implements, comes a series of lacustrine deposits, including a bed of lignite; these strata rest in a hollow denuded out of the boulder-clay, which in turn rests on sands and gravels. The estuarine beds indicate that the glacial climate of the boulder-clay was succeeded by a temperate climate and that by a second arctic climate before the implement-bearing beds were laid down. These determinations depend on the evidence derived from the relics of fossil plants, mostly seeds, found in the estuarine beds.

Mr. Kendall read a paper on the changes which many Yorkshire rivers had undergone in their courses since the glacial period. Both the Wharfe and the Nidd have been diverted from their old channels, which are still traceable, and now flow through gorges in the lower part of their courses. Similarly the Swale and the Wishe were once tributary to the Tees, though they now drain into the Derwent, which itself flows west from Scarborough, instead of east and straight to the sea. A vast amount of water has thus been brought to the Humber which did not originally belong to it. The usual discussions as to the origin of various glacial deposits between the advocates of marine action and those of land-ice work were rife on the day devoted to Pleistocene subjects, the battle ground shifting from the Isle of Man to the Vale of Clwyd and back again to Ayrshire and Kintyre.

Mr. Cornish gave the results of his work with the sand-blast and on ripple marks, in which he endeavored to distinguish between the forms caused by waves from those due to streams and wind. Prof. Milne described his seismographic work in

the Isle of Wight, where earth-tremors appear to be of constant occurrence, and stated that he had been able to feel certain tremors at a distance of several thousands of miles. Indeed, he went further and, calculating that one shock had reached his instruments from a distance of not less than 6,000 miles, he stated the extreme probability that a shock had occurred in Japan on August 31st, a prediction which was verified at the close of the meeting.

The Coral Reef Committee had to announce that so far as the boring at Funafuti went it was practically a failure, but that the results brought back by the scientific officers of the ship and by the three naturalists engaged in the investigation, were of very great importance from the points of view of anthropology, zoology, botany, geology and hydrography. The Geological Photographs Committee reported that a large part of Britain was now photographically registered in the collection of 1,400 prints which had been amassed, but there were many areas ill-represented and others almost as yet untouched. In conclusion, a discovery by Prof. Busz must not be omitted. Amongst some remarkable rocks produced by contact metamorphism round the Dartmoor granite mass he had found and isolated corundum in a felsite which had enclosed and metamorphosed a fragment of slate.

W. W. Watts.

London.

Relations of Tarsius to the Lemurs and Apes.

The systematic position of the Lemuroidea has for years puzzled the most eminent naturalists. The French zoologists, including Alphonse Milne-Edwards, Gervais and Filhol, consider the Lemurs as occupying a position entirely apart from the Apes, and moreover some of these observers find in the anatomy of the soft parts of the Lemurs close resemblances structurally to the same parts in the Ungulates. The conclusions of Filhol in regard to the position of the fossil Lemurs have not been generally accepted by paleontologists, and there is no doubt that certain characters of the dentition of *Adapis* which are like those of the perissodactyle Ungulates must be considered as cases of parallelism.

Years ago Mivart ably contended for the close affinity between the Apes and Lemurs, and Cope saw in *Anaptomorphus* the most simian lemur yet discovered. Schlosser, on paleontological grounds, derives the Anthropoids and Lemuroids from the same stem form.

Up to the present time the genus *Tarsius* has been considered to be a member of the Lemuroidea, but the recent investigations of Hubrecht on the placentation of *Tarsius* go to show that this genus has the same type of placenta as in the Apes. Accordingly Hubrecht would transfer *Tarsius* from the Lemuroid to the Anthropoid division of the Primates. In this removal of *Tarsius* to the Anthropoids, he proposes to include *Anaptomorphus*, and if the latter genus is placed among the Apes, why not place *Necrolemur* there too, as it has probably the same dental formula as *Tarsius*, and the modification of the anterior part of the dentition in *Necrolemur* resembles that of *Tarsius*.

It appears to me if this change in the classification of the Primates takes place we shall be little benefited and that it will be exceedingly difficult to discover any characters of the skeleton by which we can separate the Apes from the Lemurs. I hold that the summation of the osteological characters of *Tarsius* brings this form nearer the Lemurs than the Apes, and, moreover, I know of only one Anthropoid character in the skeleton of *Tarsius;* this is the partial closure inferiorly of the orbital fossa, by a lamina of bone extending from the alisphe-

noid to the malar. I admit this character occurs in no other known Lemuroid. However, in the fossil genera related to *Tarsius*, that is in *Anaptomorphus* and *Necrolemur*, this sphenoidal lamina in the skull is not present.

In support of the view that *Tarsius* is a generalized member of the Lemuroidea, I wish to enumerate a number of its most important dental and osteological characters: the lower incisors and canines are normal in form as in the extinct ancestral Lemurs, the lachrymal fossa is exposed as in the Lemurs, the fourth digit of the pes is longer than the third, the second digit of the pes is provided with a claw, and, lastly, the calcaneum and navicular are elongated as in *Galago* and *Cheirogaleus*. These characters are all those of the true Lemurs, and I believe they are essential. In regard to the presence of a claw on the second digit of the pes, that may be considered a primitive character, as in my opinion the Lemurs have been derived from an unguiculate form, and not from an ungulate type (*Condylarthra*).

I do not see that the characters of the dentition of *Tarsius* bear directly on the question as to its close relationship with the Apes. The upper molars of *Tarsius* are of the primitive tritubercular type, and the lower are tuberculo-sectorial. These types of teeth would be the primitive ones from which those of both the Apes and Lemurs were derived.

The form of the incisors and canines in *Anaptomorphus* is not known, but from the resemblance of the skull of *Anaptomorphus* to that of *Necrolemur* and *Tarsius* one might conclude that the anterior part of the dentition would be like that of *Tarsius*. In *Anaptomorphus homunculus*, as shown by Osborn and Wortman, there are three lower premolars, but in *A. aemulus* there are said to be only two. In other words, the last-named species is supposed to have the true simian dental formula, namely: I_2, C_1, Pm_3, M_3. I believe, however, that we may interpret the arrangement of the teeth in *Anaptomorphus aemulus* differently, and in that case the lower dental formula would read: I_1, C_1, Pm_3, M_3, or the same as in *Tarsius*.

The structure of the skull in *Necrolemur*, *Anaptomorphus* and *Tarsius* is very similar. In all we have greatly enlarged orbits and huge auditory bullæ. In comparing the teeth of these genera, we find that *Anaptomorphus* and *Tarsius* have retained the primitive tritubercular structure in their true molars, whereas in *Necrolemur* the superior molars are of the quadritubercular type, and the lower true molars have lost the antero-internal cusp. One character of the dentition of *Anaptomorphus*, as shown by Cope, relates this genus more closely to the Anthropoids than any other known Lemur; this is, that the third upper premolar has an internal cusp as in the Apes. With the exception of this special dental character, *Anaptomorphus* is a true Lemur.

In *Adapis* of the Upper Eocene of Europe the general structure of the Molars closely resembles that of the recent Lemurs, especially the genera *Lemur* and *Lepidolemur*. In *Adapis* however, the pattern of the last lower and upper premolar is nearly like that of the true molars; and on account of the complex structure of this tooth, *Adapis* has been excluded from the line leading to any of the recent Lemurs. This objection as to the *Adapidæ* being ancestral forms can now be removed, as there is a beautifully preserved skull in the collection of the Jardin des Plantes, Paris, from the Phosphorites, which represents a new genus of this family, and the last premolar in both jaws of this new type is perfectly simple in structure and of the same form as in the majority of recent Lemurs. This cranium is essentially that of a living Lemur, closely allied to

Hapalemur, but with one important exception, namely, the incisors and canines, are normal in form, and not proclivous, as in recent Lemurs. This is exactly what we should expect to find in an ancestral Lemur, as that peculiar modernization in the form of the lower incisors and canines in the Lemurs probably occurred at a very late geological epoch. In the jaw of *Megaladapis*, of the late Tertiary or Pleistocene epoch of Madagascar, the incisors are not preserved, but, from the extreme massiveness of the jaw symphysis and its upward bend, I think further discovery will show that in this form the lower anterior teeth were upright in position as in the Eocene Lemurs.

As already mentioned, the teeth of the Old World *Adapidæ* closely resemble those of the recent Lemuroidea, especially the forms included in the subfamily *Lemurinæ*. The American forms which are supposed to be related to Adapis cannot be considered as ancestral to any of the existing Lemurs, on account of the sexitubercular structure of their superior molars. The question is: Are these American genera monkeys? As before stated, it is very probable that the ancestral Lemur had a generalized type of dentition in that the incisors and canines were of the normal form, as in the Apes. The *Hyopsodontidæ* then can hardly be designated as monkeys, simply because they have retained, in the shape of their anterior teeth, the form common to to the ancestors of both monkeys and Lemurs. The term Pseudolemurs, which Schlosser has proposed to apply to fossil Lemurs, with the full number of premolars, is appropriate especially for the American fossil lemurines. Moreover, this name has the advantage of showing that these forms are not directly ancestral to the true Lemurs, but that they developed parallel with the latter.

Mivart, in discussing the relations of the Lemurs to the Ungulates, came to the conclusion, that merely on account of the similar structure of the placenta in these two groups, as a result, they cannot be considered as closely related. For we know that in the order *Edentata* there are several well marked types of placentæ, as the zonary of *Orycteropus*, (2) the diffuse *Manis* and the discoidal deciduate of the Armadillos and Sloths. Again, as Balfour remarks, "The presence of zonary placentæ in *Hyrax* and *Elephas* does not necessarily afford any proof of affinity of these types with the Carnivora." He further states that the resemblance between the metadiscoidal placenta of man and of the *Cheiroptera*, *Insectivora* and *Rodentia* is rather physiological than morphological. Balfour considers that, although the placenta is capable of being used to some extent in classification, it does not warrant its being employed except in conjunction with other characters.

In conclusion, from a study of the osteology of the recent and extinct Lemuroidea, I believe that this suborder of the Primates is related genetically to the Apes, that *Tarsius* is a true synthetic type, connecting the Lemuroids with the Anthropoids, finally *Tarsius* shows that both Apes and Lemurs have arisen from a common ancestral form.

Charles Earle.
American Museum of Natural History.

THE PRIMARY SEGMENTATION OF THE BRAIN.

In a recent paper on the 'Segmentation of the Nervous System of *Squalus acanthias*,' Dr. H. V. Neal of Harvard University, entirely sets aside the 'Metameres,' or 'Neural Segments' observed by Locy in the neural folds, as not having any phylogenetic significance whatever. This conclusion is particularly interesting when it is taken into account that Locy claims to have traced these "Neural Segments onward in an unbroken continuity until they become the 'neuromeres' of other observers."

In addition to the above, the chief con-

clusions arrived at by Neal may be briefly summed up as follows: He finds that six neuromeres are included in the cephalic plate at the time of its closure, but states that a seventh neuromere is subsequently added to this number, making seven in all which enter into the formation of the encephalon, in which they are distributed as follows—the first and second form the fore- and mid-brains respectively, the remaining five (three to seven inclusive) the hind brain.

The evidence which he advances as to the metameric value of the hind brain neuromeres concerns their correspondence with somites (Van Wijhe's somites, 2-6 inclusive), motor nerves and visceral arches. This correspondence he finds complete for all the hind-brain neuromeres, with the exception of the fourth, which however on hypothetical grounds he regards as possessing a metameric value equivelant to the others, and thus concludes "that these five hind-brain neuromeres are good criteria of the number of primitive segments in this region of the head."

The first two neuromeres (I. and II.) he regards as morphologically equivalent to the hind brain neuromeres, and considers that the absence of a motor nerve in the first is correlated with the loss of musculature of that segment, while the relation of a ventral motor root, the occulomotorius, and Van Wijhe's first somite to the second neuromere (mid-brain expansion), justifies the opinion that these structures are components of a single metamere only.

So far as can be seen by the writer, Neal's conclusions add little to our previous knowledge of the hind-brain neuromeres. One fact, however, in connection with his conclusions which is most gratifying, is that they confirm, wholly or in part, the observations of former investigators, a circumstance which he has apparently overlooked.

C. F. W. McCLURE.

PRINCETON UNIVERSITY.

CHARLES E. BENDIRE.

MAJOR CHARLES E. BENDIRE, U. S. A., Honorary Curator of the Department of Oology in the U. S. Natural Museum, died at Jacksonville, Florida, February 4, 1897, of Bright's disease. Weary of confinement indoors he went to Florida in hope of finding a milder climate where he might sit outside to enjoy the fresh air and watch the trees and birds—a hope that was not realized, for he died five days after leaving Washington.

Major Bendire was born in Hesse Darmstadt, Germany, April 27, 1836. He was a relative of Weyprecht and Payer, the Austrian Arctic explorers who discovered and named Franz Josef Land.

He came to this country in 1852, and in June, 1854, enlisted as a private in Company D of the 1st Dragoons, U. S. Army. During the next 10 years he was promoted to Sergeant, and served as Hospital Steward in the 4th Cavalry. In 1864 he was transferred to the 1st Cavalry and promoted to 2d, and soon after to 1st Lieutenant. In February, 1873, he attained the rank of Captain, and in April, 1886, was retired on account of an injury to the knee. In February, 1890, he was breveted Major for gallant services rendered on September 13, 1877, in fighting the Indians at Cañon Creek, Montana—an illustration of the subsequentness of glory in the army!

During his long period of service as an army officer he was stationed at a number of the most remote and inaccessible posts in the West, among which may be mentioned Cantonment Burgwyn, in New Mexico; Forts Bowie, McDowell, Wallen, Lowell and Whipple, in Arizona; Bidwell and Independence (the latter in Owens Valley), in California; Harney and Klamath, in Oregon; Vancouver and Walla Walla, in Washington; Boise and Lapwai, in Idaho, and Custer, in Montana. And it should be remembered that his service at most of these

posts antedated the construction of the transcontinental railroads which now traverse the States and Territories in which most of them are located.

Bendire was a man of energy, perseverance and courage, and in our Indian wars naturally took a prominent part. This part was sometimes that of a dreaded foe who followed them relentlessly over mountain and desert and penetrated their most distant retreats; sometimes that of a peacemaker, as when in the midst of the bloody Apache war he boldly visited the camp of Cochise, the celebrated Apache chief, and induced him to abandon the war path. He treated the Indians, as he did everyone else, with perfect frankness and fairness, and never deceived them. They were not long in learning that they could rely absolutely on his word, which gave him a positive advantage in all his dealings with them, for they always respected him and when not at war liked him.

Aside from his movements in the field in connection with Indian wars, he led a number of expeditions for other purposes, such as laying out roads, surveying routes for telegraph lines, and exploring unknown country—as when he crossed Death Valley in 1867, and explored the deserts of south-central Nevada as far east as Pahranagat Valley. No other American naturalist in modern times has spent half so much time in the field as Bendire, and his voluminous note books attest the accuracy and range of his observations.

It is hard to say just when Bendire's scientific work began, or even exactly when he commenced making his famous collection of birds' eggs, though it is certain that he was collecting in 1870. Like many other army officers stationed in the West, he sent Professor Baird from time to time natural history specimens and notes. When stationed at St. Louis he became an intimate friend of the eminent botanist, Dr. George Engelmann, to whose herbarium he was a valued contributor.

His earliest published writings are in the form of letters to well-known naturalists, chiefly Allen, Baird and Brewer. The first volume of the Bulletin of the Nuttall Ornithological Club (1876) contains several such letters, published by J. A. Allen.

In 1877 he published an important paper on the Birds of Southeastern Oregon, based on three years' field work in the region around Fort Harney. In all, he has written about fifty papers, most of which relate to birds and their eggs, though several treat of mammals and fishes. But the work which will carry his name and fame to future generations is his 'Life Histories of North American Birds,' of which the second volume was reviewed in SCIENCE not long ago (N. S. Vol. IV, No. 96, October 30, 1896, pp. 657-658). It is a calamity to the science of ornithology, for which he was in no way responsible, that the remaining volumes of this great work, which contains more original information on the habits of our birds than any other since the time of Audubon, Wilson and Nuttall, were not made ready for publication.

In his personal life Bendire was a man of simple habits and unusual frankness. He had an inborn aversion for all kinds of circumlocution and insincerity, and was himself a model of directness and truthfulness. He was generous, kind hearted and ever ready to help others, no matter at how much personal inconvenience, if he believed them worthy. He had a large number of correspondents in all parts of the country who considered it a privilege to contribute notes and specimens for his use. These and many others will mourn his loss, but none so deeply as the small coterie who were so fortunate as to be numbered among his intimate personal friends.

C. HART MERRIAM.

CURRENT NOTES ON PHYSIOGRAPHY.

NORTHWESTERN OREGON.

A GEOLOGICAL reconnoissance in northwestern Oregon by J. S. Diller (17th Ann. Rep. U. S. Geol. Survey, 1896, 1–80) gives new examples of mountains resulting from the dissection of peneplains. The Coast range in this district, consisting of inclined Miocene and older formations, shows uplands, bevelled across the tilted strata in gently sloping plains at various altitudes, as if the product of erosion at successive levels. A number of small monadnocks rise above the upper plain, and the narrow valleys of the streams are incised beneath the lowest. The relations of the different peneplains are not fully worked out. During the lower stand of the region, when the peneplanation was accomplished, Willamette valley of to-day was a drowned valley, like the existing Puget sound; and it is now floored with the sediments of that submergence. The sediments contain ice-rafted boulders, thought to be derived from the glaciers of the neighboring Cascade range on the east, then more extensive than now, in spite of the lower stand of the land. During emergence two of the stronger rivers seem to have maintained transverse courses across the rising peneplain (the Coast range), so that they now gather headwaters in Willamette valley. Old sea cliffs and beaches at various levels on the western slope of the Coast range record pauses during emergence; similar pauses are indicated by terraces along the river valleys. The movement of elevation continued until a five-mile belt of the existing sea bottom was added to the land; the evidence of this being found in the extension of river channels seaward from their present mouths, as determined by Coast Survey soundings under Davidson. Subsidence to the present altitude has drowned the rivers a number of miles up stream, letting the tide far inland. The present shore line is sub-mature; alternating between bold rocky headlands not yet cut back to a graded outline, and long, smoothly curved beaches of concave outline towards the sea.

GLACIAL DEPOSITS OF INDIANA.

UNDER the above title, Frank Leverett, who has for some years past carried on field studies of the drift under the direction of Professor Chamberlain, gives a summary of his results for a central state (*Inland Educator*, August, 1896, 24–32); the essay being one of a series designed by Professor Chas. Dryer, of the State Normal School at Terre Haute, for the edification of local teachers. Leverett states that the border of the drift, as indicated on his outline map, needs correction, for repeated observations have convinced him that it extends further southward than is indicated on Wright's map of the glacial boundary (Bull. 58, U. S. Geol. Surv.). The succession of glacial deposits and associated loess beds, with interglacial soils, is briefly described and the chief moraines are mapped. The terminal moraine of the Wisconsin (third) stage of glaciation is a broad ridge generally twenty feet high. Within the space of half a dozen steps one may pass from loess-covered tracts of earlier drift to the bouldery drift of this later invasion. There is an accompanying change of soil color and composition, from ashy (loess) to black (drift), of a great agricultural importance. Certain prominent moraines near the western boundary (Benton and Warren counties) are overridden by transverse or unconformable bouldery moraines. A temporary lake, apparently enclosed by ice on the east and north, explains the sands spread over the northwestern counties.

If the geographical aspects of the drift, both as to form and occupation, could be more fully stated by Mr. Leverett in another article, better work by local teachers would be still further promoted.

SCIENTIFIC GEOGRAPHY IN ITALY.

An encouraging sign of progress in geographical instruction is found in a note on the Scientific Systematization of the Study of Military Geography, by Lieut.-Col. C. Porro (Rev. Mil. Ital., 1896, 30 p.). After reviewing the various methods of geographical study for some time back, he adopts the guidance of Lapparent in emphasizing the importance of a rational understanding of the origin of topographic forms as a means of better perceiving the forms themselves, and urges such study as a basis of specialization in military geography. The Italians already being well advanced in the production of elaborate maps and reliefs, they are prepared to profit greatly by exchanging the earlier empirical methods for more modern scientific and systematic study. Geomorphology, as recognized in this country, has hitherto had no place in Italy, in spite of the beautiful variety of topographic forms on which its methods might be exercised.

NOTES ON ASHANTI.

Major C. Barter gives some Notes on Ashanti, taken while on the (British) Ashanti expedition of 1896 (Scott, Geogr. Mag., xii., 1898, 441–458). He says, in his preface, that the most he could offer, outside the military features of the campaign, would be a record of general impressions and of local accounts and traditions which his memory had retained. His interesting narrative is largely concerned with other than physiographic matters. Landing in surf boats, a fatiguing march followed across twenty miles of sandy undulating country, covered with low bushes, gradually merging in the primeval forest, of which an impressive description is given. The forest belt is about 300 miles broad, and beyond its northern border, which limits Ashanti, come rich prairie plains, with healty climate and an abundance of big game, under the Sultan Samory. The forest country is undulating, except in isolated hilly districts of small area; the water courses are broad and swampy. The clearings about villages are connectad by paths, on which from one to four men can walk abreast. The excessive dampness is relieved by the Harmattan, or 'Doctor,' a steady cool breeze which blows from a northerly direction during the winter months, apparently a local manifestation of the normal northeast trade.

This note is offered not so much for its physiographic value as for a sample of the gleanings that may be gathered from the usual observations of the military explorer. If British military training were based on the recommendations of Porro, above, the geographical harvest of foreign expeditions would be richer; but those in charge of the program of British military schools might plausibly say that they are so well satisfied with the success thus far attendant on their graduates that they find no reason for altering their curriculum.

W. M. Davis.
Harvard University.

CURRENT NOTES ON METEOROLOGY.

CLOUD HEIGHTS.

In a recent number of *Nature* (Dec. 31) Clayton makes some important suggestions concerning possible errors in calculating the heights of certain forms of clouds by means of theodolites and photogrammeters. At Blue Hill Observatory the average height of nimbus obtained by theodolite measurements is 6,814 feet, while the height of the base of the same kind of cloud as shown by sending kites into it is usually less than 1,640 feet. There is seen to be a considerable discrepancy here. Evidently the kite measurements are the most accurate, and there can be no doubt that the nimbus cloud belongs lower down in the cloud classification than the position it now occupies in the International Nomenclature, as given in the new Cloud Atlas. In the

Atlas the nimbus and the strato-cumulus are placed together under the heading *Lower Clouds*, and their average height is given as about 6,600 feet, or considerably over a mile, while the Blue Hill measurements make the height of the nimbus less than half a mile. The more the future of kite meteorology is considered, the more numerous do the opportunities seem to become in which kites will be of great service. This measurement of cloud heights by means of kites is certainly one of the most important uses to which they have yet been put.

FOG POSSIBILITIES.

IN a short article under the title *Fog Possibilities*, in Harper's Monthly Magazine for January, McAdie regards it as a possibility of the future that fogs will be dispelled by artificial means. Lodge has shown by his experiments that the dust in the air, which is of such importance in fog and cloud formation, can be removed by electrification. The fog may be dissipated by gentle electrification, which increases the size of the dust particles until they settle, or by strong electrical discharges, which scatter and precipitate the particles. McAdie believes that "fog dispellers might be placed upon war ships, ferry boats and at all terminal depots and crowded thoroughfares." "We cart away," he says, "from our busiest streets the snow or solidified vapor of the air. Is it not better economy to attempt the conquest of the water vapor in another form?"

INTERNATIONAL BALLOON METEOROLOGY.

COMMENTING on the subject of balloon meteorology, M. de Fonvielle, in a recent letter to the editor of SCIENCE, says: "It should be deeply regretted if your great nation should not join in these experiments, which are executed in a friendly spirit by three fractions of the European family which are not always in harmony on the surface of the earth. * * * One important fact seems to result from all the experiments tried in France. When the balloon reaches a high altitude, 30,000 feet, at least, it is sure to be discovered in some locality eastward from the Paris meridian. This observation, which is * * sufficiently well established, gives a warning against the execution of these experiments from the eastern coast of the Atlantic. Neither New York, Philadelphia nor Washington are to be selected as a proper starting point. St. Louis should be eligible and a lot of other cities. The same might be said of any place west of the Rocky Mountains, especially of any place selected in California, as the Mt. Hamilton Observatory."

R. DEC. WARD.
HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE SHELL GORGETS OF NORTH AMERICA.

THE study of this interesting class of antiquities is aided by the description of one from Mexico by Professor Frederick Starr in the 'Proceedings' of the Davenport Academy, Vol. VI. It was found in the State of Michoacan, and a cut of it is inserted. Many points of similarity are noted between it and those from Tennessee, Georgia and Missouri, described by Holmes and Thruston. These are sufficient, in Professor Starr's opinion, to affiliate the Mexican example to those of the Mississippi Valley as members of one and the same art-development.

The possibility that these objects might have been carried as articles of trade from one region to another is considerable. The finding of one or several in a spot does not of necessity infer the identity of culture. The motives are Aztecan, but, unless supported by other indications of that peculiar school of design, it is more likely they were 'intrusive' objects.

THE RED RACE OF MADAGASCAR.

It is a curious fact that the older navigators who visited Madagascar describe a red race there, which now seems to be extinct. In the 'Bull. de la Soc. d'Anthropologie,' of Paris (Tome VII., fasc. 5), Dr. Bloch collects a number of extracts bearing upon this. The red people are described as tall, without beards, nose prominent, hair straight and long, the features of the European rather than Mongolian type, and the color of the skin red or reddish. This race, the description of which corresponds singularly with that of the North American Indian of the Algonquian or Iroquoian stock, appears to have passed out of existence about the middle of the last century. It is to be hoped that at least some ancient cemeteries may supply their osseous remains. One writer, Flacourt, believes them to have been the ancestors of the Hovas, but the physical traits do not correspond.

GLACIAL MAN IN OHIO.

Especial interest attaches to an article in the *American Geologist* for November, 1896, by Professor E. W. Claypole, on 'Human Relics in the Drift of Ohio.'

It is principally taken up with the description of a polished slate axe disinterred in 1886 from the bottom of a well, 22 feet deep, near New London, Ohio. It was neatly and symmetrically carved, and deeply weathered. The stratum was a late glacial deposit, lying directly upon the boulder clay.

Professor Claypole used all practicable precautions in examining the well digger who found the specimen (ten years before), and in confirming his statements. He presents the evidences of authenticity with as much conclusiveness as they will bear; and he meets the various objections which will arise from the length of time, from the artistic finish of the specimen and from the veracity of the witness. His article is excellently studied, and if it fails to convince, it will be from the weakness of the case, not from deficiencies in presenting it.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

The question as to whether illuminating gas or fuel gas is completely consumed in an ordinary burner possesses a considerable interest, not only from an economic, but also from a hygienic standpoint, since even small quantities of carbonic oxid are dangerous to health. Investigations have shown that in free burning flames, as well as in the Welsbach burner, practically no unconsumed gas is given off, but doubt has been thrown by the experiments of Vivian B. Lewes on flames which impinge on cold surfaces, as in gas stoves for cooking and under water baths in the laboratory. This point has been carefully studied at the Technische Hochschule at Karlsruhe by F. Haber and A. Weber, and their results show that with a sufficient supply of air, even under cold surfaces, the gas is completely burned, but if the air supply is insufficient decided quantities of carbonic oxid may be formed. Thus with the laboratory Bunsen no danger is to be apprehended, but with gas stoves care is necessary to see that there is a plentiful air supply.

In continuing his work upon metallic lithium M. Guntz finds that it has a strong affinity for carbon, forming a carbid Li_2C_2, which is decomposed by water with the formation of acetylene. When lithium is heated in contact with carbon it unites with it directly. When compounds which give lithium by dissociation, as lithium hydrid or lithium nitrid, are heated with carbon, the carbid is formed, in the latter case accompanied by large quantities of lithium cyanid. Carbonic oxid and carbon dioxid

are both absorbed by lithium with formation of the carbid. Heated in an atmosphere of acetylene or of ethylene, the gas is completely absorbed and a definite mixture of lithium carbid and lithium hydrid formed. Lithium seems, however, to be almost without action upon methane.

M. PETIT has carried out a series of experiments at the University of Nancy on the action of waters containing dissolved salts upon iron. He was led to the work by the fact that the waters of the Moselle (and the same is true of many other waters) attack iron pipes and reservoirs, often penetrating them, while large quantities of iron oxid are deposited. The action is due, he finds, chiefly to the action of carbonic acid, free or in the state of combination in calcium bicarbonate. Such water rapidly attacks the iron with liberation of hydrogen. The iron is at first present in solution as ferrous carbonate, but is rapidly oxidized by dissolved oxygen and deposited as ferric oxid. If other salts are present the action is increased. Thus alkaline sulfates are reduced by the iron to alkaline sulfids, and these are changed by the carbonic acid to alkaline carbonates, while the liberated sulfur forms, with the iron, ferrous sulfid. Common salt acts most energetically, here also sodium bicarbonate being formed. This action of iron upon calcium bicarbonate and on carbonic acid explains the action of such waters on iron pipes, and also the purification of water by spongy iron.

The action of certain hard waters on brass (faucets, etc.), may possibly be similarly explained, the carbonic acid acting upon the zinc and leaving the brass in an almost porous condition. J. L. H.

SCIENTIFIC NOTES AND NEWS.

A DIRECTOR OF SCIENTIFIC WORK FOR THE DEPARTMENT OF AGRICULTURE.

THE Secretary of Agriculture, in his fourth annual report to the President, calls special attention to the benefit that has resulted from the use of the classified civil service in the Department, and urges that this system should be completed by the appointment of a permanent director of scientific work. We have already urged this step, but it may be well to repeat the arguments of the Secretary of Agriculture.

The Secretary, being a Cabinet officer, must be changed with each new administration, and the Assistant Secretary is subject to the same conditions. These executive officers are necessary, but another officer is needed to direct the work of the various scientific bureaus of the Department, under the general authority of the Secretary, and to give permanence to the policy of the Department. In order to accomplish the best results, the Department must have a settled policy with regard to all its scientific work. This Department has less relation to the general executive business of the government, and less connection with what is usually called politics, than any other Department of the government. In fact, the scientific work of the great bureaus, divisions and surveys should be kept free from politics to be efficient and impartial. The numerous bureaus and divisions do not have under the present organization, in fact cannot have, the attention and direction which the interests involved demand. After a change of administration the Department is practically headless, and to a great extent helpless, until the new Secretaries have had time to master the details of the technical work. A director of scientific divisions is needed, therefore, if for nothing else, to carry on the scientific work of the Department from one administration to the next. Further, the Secretary of Agriculture cannot be expected in all cases to unite the necessary executive ability with adequate scientific training, and his duties are already onerous, a large part of the work of the Department extending over the whole country.

The Senate Committee on Agriculture and Forestry last year recommended the passage of the bill establishing the office of 'Director in charge of scientific bureaus and investigations for the Department of Agriculture,' but the bill was introduced too late for consideration dur-

ing the last session of Congress. The estimates for the next fiscal year contain, however, a recommendation for an appropriation of $6,000 per annum for this office, in the expectation that it will be created by Congress.

YOUNG'S 'REVERSING LAYER.'

In a careful review of the progress of astronomy during the year 1896, published in the London *Times* of January 14th, the author writes: "At Novaya Zemlya, Mr. Shackelton, using a spectroscope without a slit—since the extremely narrow sickle of light at the moon's limb made a slit unnecessary—and timing the exposure of his plate to the precise moment of the progressing eclipse which corresponded to that at which Professor Young made his classical observation by eye in 1870, was fortunate enough, with an exposure of half a second, to secure a permanent record of Young's reversing layer. It consists of a very narrow spectrum of bright lines, which are, indeed, the Fraunhofer lines reversed. A plate exposed two seconds later showed a comparatively simple chromosphere spectrum. The congratulations of astronomers are due to Professor Young upon this complete, though late, confirmation of his observation of 1870 and of his views, speaking broadly, of solar absorption founded upon it. Professor Young, after a careful comparison of the Novaya Zemlya photograph with a Fraunhofer spectrum taken with the same prisms, but with a collimator and slit before the prisms, writes:

"'With very few exceptions every Fraunhofer line finds its correlative in the 'flash spectrum.' I do not see but that the evidence as to the origin of the great majority of the Fraunhofer lines within a very short distance from the photosphere is practically complete. Very possibly some of the absorption occurs at higher levels; but it seems to me clear that most of the absorbing metallic vapours are at the base of the chromosphere, in a thin stratum or layer, if one chooses to call it so; not that I suppose it to be a quiescent sheet or a stratum in any different sense from the chromosphere itself.'

"Professor Young further points out that it would be absurd to compare the number of bright lines of this 'flash' spectrum, taken with two prisms only, a lens of 10-in. focus and no slit, with the number of dark lines in Rowland's great solar map, photographed with a large concave grating, a fine slit, and every possible refinement of adjustment."

MOTOR CARRIAGES.

In view of the scientific and practical importance of motor carriages, we give the report made by the jurors in connection with the recent exhibition at the Crystal Palace, London:

"Although none of the vehicles exhibited approached that degree of perfection which would place them beyond the adverse criticism which condemns any evidence of an unrealized attempt, they are of opinion that several of the vehicles shown and worked in the Crystal Palace grounds have reached a degree of practical sufficiency meriting some distinctive mark of appreciation. Most of the vehicles, which have withstood the test of considerably hard daily work, were propelled by motors actuated by the internal combustion of light oils, such as benzoline. The use of these light oils in this country has been discouraged, although the cause of this is probably due more to fiscal and to other restrictive regulations than to any real evidence of danger attaching to it. Most of the carriages exhibited and worked in the grounds have motors supplied with hydrocarbon vapor, produced by the passage of air through some form of carburetter containing benzoline. This vapor, mixed with air, and compressed and heated by the incoming stroke of the motor piston, was, with one exception, ignited by an electric spark, obtained by means of a secondary battery and induction coil. The one exception was the carriage of Peugeot, fitted with a Daimler motor, and lent by Sir David Salomons. This vehicle, however, did not come within our cognizance at the time of our visit with respect to the merits and awards.

"We have carefully considered the various points in the construction, detail and working of the several vehicles and their motors, and we are very strongly of opinion that these benzoline motor carriages do, even in their present state of advance towards sufficiency, show that such motors may be practically employed for propelling vehicles of various kinds and for various purposes. The carriage of M. Delahaye showed a distinct step in advance upon the

other benzoline motor-vehicles; its double small horizontal cylinders, with opposite cranks and other details, including a very satisfactory tubular water cooler, with simple force pump circulator, secures steadier motion, freedom from escaping steam or water vapor, and more power in a given space. He has placed before us a carriage which only needs the development to which experience will point the way.

"These latter remarks pertain equally with regard to the steam vehicles exhibited and worked. The steam vehicles undoubtedly showed the greatest power and the greatest flexibility or range of power. The ability to stop the motor and start without manual assistance was seen to be a noteworthy advantage, not only as a matter of convenience, but as a means of avoiding an otherwise very persistent vibration of the vehicle when standing. The steam carriage exhibited by M. Serpollet, although not of the maker's most recent form, is one which merits particular notice for its originality, its value as an indication of the possibilities with a steam boiler and engine of the types used, its superiority with regard to range of power, and its exemplification of the advantages already referred to as to convenience in several respects.

"The steam van exhibited by the Thornycroft Steam Carriage and Wagon Company we also recognize as a very meritorious illustration of the most useful lines upon which arrangement and development of a most important class of motor-vehicles may proceed. The jurors considered it matter for regret that no electrically propelled vehicle had been submitted for trial."

GENERAL.

HON. JAMES WILSON, of Iowa, will be Secretary of Agriculture under the next administration. He is director of the Iowa Agricultural Station and professor of agriculture in the Iowa Agricultural College. He was for many years a teacher in the country schools and has been since a practical farmer, having earned the money for the purchase of the farm of 1,200 acres, said to be one of the best equipped and best managed in the State, which he now cultivates. Professor Wilson has served three terms in Congress. He was born August 16, 1835, in Ayrshire, Scotland.

IT is reported that Judge Joseph McKenna, of California, will be the next Secretary of the Interior.

THE St. Petersburg Academy of Science has elected M. Joseph Bertrand, the permanent secretary of the Paris Academy of Sciences, an honorary member.

PROFESSOR E. E. BARNARD, of the Yerkes Observatory, University of Chicago, has sailed from New York for Southampton, on his way to London. He will attend the meeting of the Royal Astronomical Society on February 12th, to receive the gold medal awarded to him for distinguished service to the cause of astronomical science.

A SANITARY conference on the Bubonic Plague opens at Venice to-day. The representatives of Great Britain will not favor quarantine regulations, but the Continental governments seem apprehensive lest the plague may spread to Europe. Dr. Koch has been summoned by the German government from South Africa, where he has been studying the rinderpest, to head a special commission which will be sent to Bombay to investigate the plague and report on measures that should be taken to prevent its introduction into Europe. Similar steps are being taken by the governments of Russia and of Italy. The plague has not appeared in eastern Europe since 1721 and not in England since 1665, when upwards of 100,000 persons died from the disease. The Black Death of the fourteenth century, which in three years destroyed 24,000,000 Europeans, was perhaps the bubonic plague. The plague is essentially a *miseriæ morbus* and the present sanitary conditions are such as to make an epidemic unlikely. Still a man who is so little an alarmist as Lord Lister said in a recent address in Belfast that the plague might be easily carried from Bombay in ships. "Rats were liable to contract it, and a rat making its escape from a ship coming from Bombay—say, to the Thames or to Belfast Lough—might carry the plague ashore and, entering any of their slums, might affect human beings with this dreadful disease."

MT. ACONCAGUA, in the Andes, over 24,000

feet in height, has been ascended by the Swiss guide, Zurbriggen. He was in the company of Mr. Fitzgerald, who was unable to reach the summit.

At the International Exhibition at Brussels in 1897 special efforts will be made to secure an adequate representation of the sciences. Space for scientific exhibits will be given free of charge and a considerable number of prizes are offered.

The King of Belgium has offered a prize of about $5,000 for an essay on the sanitary conditions of equatorial Africa. Papers for competition should be presented by July 1st of the present year.

A public library and museum will be founded at Cettigne, Montenegro. The antiquities found in the principality itself will be deposited in the museum. The excavations recently made at Dukla have produced satisfactory results.

We regret to record the deaths of Baron von Ettingshausen, professor of botany at the University of Gratz, at the age of 71 years; of Dr. Edward Ballard, F. R. S., the author of works on public health and other medical subjects, aged 66; of M. Martini, the inventor of the Martini rifle; of Dr. Wilhelm Deeke, the German archæologist, at the age of 66; of Kristian Bahnson, the Danish ethnologist; of Joseph D. Weeks, editor of the *American Manufacturer*, at Pittsburg, Pa., and known for his contributions to economic geology; and of Giuseppe Protonotari.

According to *Nature*, the scientific expedition organized by the German government to study the economic and industrial conditions and possibilities in the Far East intended to start from Bremen on January 27th, on board the North German Lloyd steamer *Sachsen*. The nature and scope of the investigations to be undertaken were discussed and settled at a recent meeting at the Ministry of the Interior.

Natural Science, quoting from the *Daily News*, reports that the Imperial Natural History Society of St. Petersburg, intends to publish a Flora, first of European Russia and afterwards of Russia in Asia and the Caucasus.

Senator Gallinger has presented, by request, in the Senate, a bill for a department of health proposed by the Pan-American Medical Congress.

A bill introduced into the Wisconsin Legislature provides for a State bee inspector to suppress foul brood among bees. The wholesale valuation of the honey and beeswax produced annually in Wisconsin is $160,000.

At a meeting of the Fellows of the Royal Botanical Society, on January 30th, it was agreed that the use of the gardens should be offered to the Lord Mayor, the Chairmen of the London County Council and the London School Board, and the secretaries of societies desirous of holding receptions.

Mr. Macartney stated recently in the British House of Commons that the question of the unification of time, which is a very debatable one, has received long and careful consideration for many years. The alteration of the astronomical day cannot be effected for the sea alone, as it affects astronomers even more closely than sailors, and it must also be carried out by international agreement. Foreign powers publishing astronomical ephemerides were consulted in 1894, and when it was found, from the replies received in 1895, that the change would not be accepted by all these the Foreign Office was requested to inform the powers in question that no further steps would be taken by the British Admiralty. The Nautical Almanac for 1901 has therefore been calculated on the existing system.

An Italian Electro-technical Society has been formed in Milan, with Professor G. Ferraris, of Turin, as its first president.

Mr. Uriah A. Boyden, of Boston, has offered, through the Franklin Institute of Philadelphia, a prize of $1,000 to 'any resident of North America—including Mexico and the West Indies—who shall determine by experiment whether all rays are or are not transmitted with the same velocity.' The papers must be submitted before January 1, 1898.

We learn from *Nature* that the University of Catana has been presented with the Island of Cyclops, off the coast of Sicily, by Signor Gravina. The island is only a kilometer in circumference, but its configuration is peculiar, and the center is about one hundred meters

above sea level. It is proposed to construct upon the island a laboratory for investigations in zoology and pisciculture.

THE Boston Society of Medical Sciences has begun the publication of a journal, which is issued, for the present, for free distribution. It contains authors' abstracts of papers presented at the meetings of the Society, and is published promptly after each meeting. A vote of the faculty of the Harvard Medical School requests 'each head of department to have, at least, a summary of the scientific investigations made in his department presented at a meeting of the Boston Society of Medical Sciences for preservation in its journal,' so that the journal will contain a summary of what work of this nature is done in this school. Similar action has been taken by the biological and physiological departments of the Massachusetts Institute of Technology, and contributions of the same nature are promised from Clark University and from the experimental laboratories of the Massachusetts General and the Boston City Hospitals. Papers, or abstracts of papers, upon subjects connected with the medical sciences will be welcomed from persons who are not members, and, if approved by the Council, will be presented at these meetings, and abstracts will be given a place in the Journal of the Society. All communications should be addressed to the Secretary of the Boston Society of Medical Sciences, Harvard Medical School Boston, Mass.

THE general dissatisfaction with the position of geography in secondary schools, and the strong efforts made on every hand for its improvement, are the justification of adding one more to the list of educational journals; the *Journal of School Geography* having just made its appearance. Professor R. E. Dodge, of the Teachers' College, New York, is the responsible editor, with five associate editors, Messrs. Davis, Hayes, Kümmel, McMurry and Ward. The first number contains an introductory statement by the editor; Home Geography, by W. M. Davis; Some Things about Africa, by C. C. Adams; Geographic Instruction in Germany, by Will S. Monroe; Suggestions Regarding Geography in Grade Schools, by R. E. Dodge, and a variety of notes and reviews. Readers of SCIENCE, as possible writers for this journal, should address the editor, Teachers' College, 120th St. West, New York City; as subscribers, they should send a dollar for ten yearly numbers to the publishers, 41 N. Queen St., Lancaster, Pa.

THE lecture on Variation of Latitude, by Professor J. K. Rees, before the New York Academy of Sciences, April 29, 1895, has been reprinted by the Smithsonian Institution from the report in SCIENCE, New Series, Vol. I., No. 21. The paper is made part of the Smithsonian Report for 1894, pp. 271–279, and is also printed as a separate pamphlet.

Nature states that following the example of the Institution of Civil Engineers, the Society of Civil Engineers of France has built itself a magnificent house, which was opened with great ceremony, on January 14th, by the President of the French Republic. A large number of guests were present at the soirée, including representatives of the various French technical societies. The only English society represented was the Iron and Steel Institute, who sent Professor Roberts-Austen. The new building, which is situated in the Rue Blanche, Paris, was designed by M. F. Delmas, and was erected in 262 days. It comprises in the basement engine-rooms and store-rooms, on the ground floor the meeting-room, on the first floor reception-rooms for the members, on the second floor the secretary's office and the council-room, and on the third floor the library. Access to the various floors is obtained by means of an electric lift. The meeting-room contains seats for 500 persons, and the floor is so arranged that it may be horizontal for receptions, or inclined so as to convert the room into an amphitheatre for the meetings. The floor weighs thirty tons, and its transformation from a horizontal to an inclined position is effected with great rapidity by means of hydraulic machinery.

Natural Science reports that the Committee of the International Geographical Congress, held in London in 1895, has recently sent to the various geographical societies, resolutions, urging the importance and desirability of: (1) Antarctic exploration; (2) a geographical bibliog-

raphy, compiled by various states; (3) a topographical survey of Africa; (4) a map of the earth on a scale of 1:1,000,000, with the meridian of Greenwich and metric measurements; (5) the continuance of physical investigations lately made in the Baltic, North Sea and North Atlantic; (6) an international system of seismographic stations; (7) agreement between the various geographical societies at to the spelling of foreign names; (8) the printing on all geographical maps henceforward the date of their publication. Further, they request the opinion of the societies as to the application of the decimal system to the measurement of time and of angles.

A CORONER'S jury at Jamestown, N. Y., has rendered a verdict to the effect that Spurgeon Young came to his death on January 24th from diabetes and nervous exhaustion caused by hypnotic practices performed by persons who are specified. It is said to be probable that the matter will be carried to the courts.

ACCORDING to the *British Medical Journal*, M. Julien Dumas has announced his intention to interrogate the French government on the abuse of the Bertillon system of measurement. M. Dumas asserts that the calculations made by M. Bertillon are far from correct. He has had in his possession measurements taken of the same person at an interval of ten years. There were not two alike. M. Dumas expressed his desire to visit the anthropometric service. The Minister of the Interior and the Police Prefect asked him to name his day. M. Bertillon, with great courtesy, explained his system. He sent for a woman who had refused to give her name. She then said her name was Garcias, her birthplace Bordeaux. Measurements were taken. M. Dumas, being initiated, found without assistance the photograph of this woman, whose real name was Tosas, and her birthplace was not Bordeaux. Much astonished he warmly praised anthropometry. He carried away with him four or five books on the subject. In one of them he found three photographs typical of the criminals most often met with. One of these was of the woman measured that morning, kept on the premises, according to M. Dumas, to illustrate the system.

THE Russian National Health Society has celebrated, in the manner proposed, the Jenner Centenary. Addresses were made by the Grand Duke Paul, Dr. Kudrin and Dr. Cormillo. Gold medals for the best works on vaccination were awarded to Dr. Layer, of Bordeaux; Dr. Miller, of Moscow, and Dr. Glagolef. The exhibition in connection with the celebration is said to be very full and interesting.

THE Baroness de Hirsch has given $300,000 to found a hospital on the Mediterranean coast for English consumptive children.

THE *Botanical Gazette* states that $6,000 has been appropriated for the erection of a research laboratory at Buitenzorg.

IT is stated in the *British Medical Journal* that the Society of Neurologists and Psychologists of Moscow has appointed a special committee (1) to report upon the present state of inebriety in that city, and (2) to draw up a scheme for the erection of a hospital for inebriates.

THE Secretary of Agriculture, in his report to the President, calls attention to the fact that during the fiscal year just ended the exported products of American farms aggregated a value of $570,000,000. That is a gain of $17,000,000 over the preceding year. During the fiscal year 1896 agricultural products make up only 66 per cent. of the total exports of the United States, as against 70 per cent. in 1895, 72 per cent. in 1894, and 74 per cent. in 1893. But the reason of a relatively decreased value of 4 per cent., with an increase in the absolute valuation of agricultural products shipped in the year 1896, amounting to $17,000,000 more than those of the preceding year, 1895, is solely due to the unprecedented sale abroad of American manufactured goods and commodities, the exports of which from the United States jumped from a valuation of $184,000,000 in 1895 to $228,000,000 in 1896.

THE *Lancet* states that, at a recent meeting of the Plymouth Borough Council, the question of the acquisition of Dartmoor by the County of Devon, in order to prevent further encroachments, was discussed. This scheme, which was submitted by the Dartmoor Preservation Association, was unanimously ap-

proved of, and the Council pledged itself to bear its fair share of the cost of purchasing 130,000 acres of Dartmoor from the Duchy of Cornwall, provided that the county authorities have power to preserve all objects of archæological and antiquarian interest and the indigenous plants and animals. The other Devonshire authorities have also promised their support to the scheme.

THE correspondent of the *British Medical Journal* at the Cape of Good Hope writes that Professor Koch joined Dr. Edington, the bacteriologist, to Cape Colony, early in December, and that a number of *post-mortem* examinations of animals were made by them together. In the beginning of October, when the disease had passed well within the lines of railway so as to be easily accessible, Dr. Edington converted a saloon car to serve as a laboratory, and went with a veterinary assistant, Mr. W. Robertson, and his secretary, Mr. Guthrie, to the infected area. Some difficulty was at first experienced in getting the assistance of the chief of the Kaffirs there, but eventually, with the assistance of some Fingoes, a camp was established, and bacteriological and pathological investigations were begun. It was at this camp that Professor Koch studied the *post-mortem* appearances, and the virus obtained from these animals is now being investigated at Kimberley in a laboratory which has been just set up by the bacteriological department, and it is probable that Dr. Koch and Dr. Edington will shortly work there together. The inoculation experiments with blood made at the camp by Dr. Edington and his assistants showed that a rise of temperature was thus produced usually after about four days, but not always, as the rise was sometimes delayed. The blood examined showed the presence, in most cases, of bacillary forms and some irregularly spherical organisms. In some instances scarcely anything was to be seen, but if care were used the bacillary forms could be recognized. A short bacillus about 2 μ long and 0.5 μ broad has been isolated, which has been used for inoculation with positive results. As, however, within the past six weeks 20,000 cattle have died in the country in which the rinderpest camp is situated, it is evident that no definite statements can be made until the cultures have been tested in an area free from the disease.

THE following notes on French explorations are taken by *Natural Science* from *Anthropologie*. Mr. Clozel, Administrator of the French Possessions on the Ivory Coast, is endeavoring to make valuable ethnographic and geological collections. Important results are expected from two such enthusiastic explorers as Messrs. Bonnel de Mézières and de Béhagle, who are starting for Central Africa. Mr. Bonin has returned to Tonkin from the south-western provinces of China, whence he brings much material and many facts of an ethnographical and anthropological nature. On their way from Turkestan to Siberia, Mr. Chaffanjon and his party have gathered large collections of the fauna and flora, and accumulated much information regarding ethnography and geography. In Siberia, too, Baron de Baye has been carrying on his archæological and ethnographical studies. Mr. E. Blanc, who has been to Nijni-Novgorod, is bringing back rich scientific collections. Mr. Raoul, Official Colonial Chemist, is starting on government business for Borneo, where he hopes to carry on scientific studies. The Hourst expedition, whose return, which has been already noted, has proved the navigability of the Niger from Bammako to the sea.

ACCORDING to the *London Times*, the Colonial Office, the Natal and Cape governments and the Board of Agriculture have been in communication for the past month as to the best means of preventing the cattle plague in South Africa from spreading into either Natal or the Cape Colony. Various inquiries have been made as to what steps should be taken, and recently at the Board of Agriculture, a special conference of heads of departments concerned was held to consult together on the subject. The chief officials concerned of the Board of Agriculture and the Colonial Office met the Agents-General of Natal and the Cape Colony and other Cape authorities. Further meetings will be held on the subject, and it is contemplated that the government will sanction every effort to save the colonies of Natal and the Cape from rinderpest.

ACCORDING to *Industries*, the Parliamentary

return as to street and road tramways during the year ending June 30, 1896, signed by Mr. Francis J. S. Hopwood, is just issued. It shows that the total capital expended in England and Wales during the year was £11,742,204, as compared with £11,685,355 in the preceding year. The total for the United Kingdom was £15,195,993, against £14,956,343. The length of line open for public traffic in the United Kingdom was 1,009 miles, an increase of 27 miles on the preceding year. While the horses used by the companies increased from 32,273 in 1894-95 to 35,621 in the succeeding year, the number of locomotive engines belonging to the companies decreased by two. The engines numbered 568 in 1895, as compared with 452 in 1896 and only 14 in 1878. The total number of passengers carried on the tramways in the United Kingdom during the year was 759,466,047, against 661,760,461 in the preceding year; the working expenses £3,105,511, against £2878,490; and the net receipts £1,046,505, against £855,200. There were 37 tramways belonging to local authorities, with a total mileage of 335 as compared with 116 belonging to other than local authorities with a mileage of 673.

The Annual General Meeting of the Royal Meteorological Society was held on January 20th, Mr. E. Mawley, President, in the chair. The Secretary read the report of the Council, which showed that the Society had made steady progress during the past year, there being an increase of seventeen in the number of Fellows. The President then delivered an address on 'Shade Temperatures,' in which he stated that of all meteorological observations there were none approaching in importance those made of the temperature of the air, generally known as 'Shade Temperature.' Indeed, the first question invariably asked in regard to almost any climate was as to its temperature. Mr. Mawley traced the history of the different methods of exposing thermometers since the time that regular observations of the weather had been made in this country. For many years open screens were most favored by meteorologists, that devised by Mr. J. Glaisher, F.R.S., and the late Astronomer Royal (Sir G. B. Airy) being the pattern principally used. In 1864 Mr. T. Stevenson, C.E., invented an admirable form of closed screen with lowered sides, which was considered preferable to the open type of screen, and has now almost entirely superseded the Glaisher Stand. In 1883 the Stevenson screen was considerably improved by a committee of the Royal Meteorological Society. Mr. Mawley then described his own experiments at Croydon and Berkhamsted, as regards this improved screen, known as the Royal Meteorological Society's pattern. He showed that the only two defects which had been attributed to this form of thermometer exposure were virtually non-existent, and therefore advised its general adoption both in this country and on the Continent. Mr. Mawley had recently made observations in the Stevenson screen, and also in the screens used in France and Germany, and the conclusion he had come to was that the results obtained in the Stevenson screen were not only the nearest to the true air temperatures, but also more likely to be strictly comparable with temperatures taken in a similar screen but with different surroundings elsewhere.

UNIVERSITY AND EDUCATIONAL NEWS.

The will of the late Mrs. Horatio Lyon, of Springfield, Mass., gives, among other public bequests, $10,000 to Monson Academy, $10,000 to Pomona College and $10,000 to Menden Free Library.

Harvard University has received from Mr. J. Howard Nichols $5,000, to be used for the founding of a new scholarship, preference being given to a student from the State of Alabama.

The will of tho late Charles Willard, of Battle Creek, Mich., leaves $40,000 to the Baptist College at Kalamazoo, Mich., and $40,000 for a library building for the city schools at Battle Creek, Mich.

The new physiological and pathological laboratories of Queen's College, Belfast, were formally declared open on January 19th, and on the following day an address was made by Lord Lister. The building contains two floors about 80x40 feet in size, the lower one being devoted to physiological and the upper to pathological laboratories.

DR. L. A. BAUER has been appointed assistant professor of mathematics and mathematical physics at the University of Cincinnati. He will not enter on his new duties before September.

DR. R. W. T. GÜNTHER has been elected fellow of Magdalen College, Oxford, and tutor of natural science.

DISCUSSION AND CORRESPONDENCE.

COMPLIMENT OR PLAGIARISM.

WE have no occasion to withdraw any of our previous statements by reason of Professor Halsted's second communication.

We still maintain that "the same order may be found in Newcomb's Elements of Geometry." After proving that *by dividing the arc we divide the angle* and, conversely, *by dividing the angle we divide the arc*, Newcomb gives the following problems, which we compare with Halsted's:

NEWCOMB.	HALSTED.
PROBLEM I. *To divide a given circle into 2, 4, 8, 16, etc., equal parts.*	PROBLEM I. *To bisect a perigon.*
PROBLEM II. *To divide the circle into 3, 6, 12, 24, etc., equal parts.*	PROBLEM II. *To trisect a perigon.*
PROBLEM III. *To divide a circle into 5, 10, 20, etc., equal parts.*	PROBLEM III. *To cut a perigon into five equal parts.*
PROBLEM IV. *To divide a circle into fifteen, etc., equal parts.*	PROBLEM IV. *To cut a perigon into fifteen equal parts.*

Professor Halsted must think us very childish, indeed, if we assert that the word perigon is found in several geometries when the word is found in only Halsted's books and our own. He will find the word in Smith's Introductory Modern Geometry of Point, Ray and Circle, in Dupuis's Elementary Synthetic Geometry, in the later editions of Newcomb's Elements of Geometry, in Faifofer's Elementi di Geometria. But, perhaps, Professor Halsted will say, "All these books appeared after my Metrical Geometry in 1881, and these authors took the word from me." We have reason to believe that W. B. Smith, Newcomb and Faifofer all did see the word for the first time in Halsted's books.

The question then remains: "Where did Professor Halsted get it? Did he invent it, as he substantially asserts, or did he find it ready made?" This we cannot answer. We can only say we know where he might have found it.

In Sandeman's Pelicotetics, or the Science of Quantity, Cambridge [England], Deighton Bell and Co., 1868, which Professor Halsted might have seen in the Princeton University library, or in the Peabody Institute library at Baltimore, we read (page 304): "A PERIGON is the angle without any overlapping bounded by two straight lines lying in the same straight line upon the same side of their common end.

"A straight line being everywise alike upon all sides everywhere throughout is in any plane through it anglewise alike upon both sides at any point in it, and hence half a perigon or a HEMIPERIGON is the unoverlapping angle bounded by two straight lines lying in the same straight line upon opposite sides of their common end. A right angle is both one-half of a hemiperigon or a HEMISEMIPERIGON and one-fourth of a perigon."

That this same book was in the hands of Instructor Lefevre of the University of Texas, when he wrote his Number and its Algebra is fairly obvious from the following extract:

PELICOTETICS.	NUMBER AND ITS ALGEBRA.
"Driven to the * * * outrageously overtowering extravagance and absurdity of finding and raising high as a principle that a chain of reasoning to be strong and good need not have meaning in every link: that, in other words, the conclusiveness of an argument has nothing to do with the intelligibility of its several steps, or that things may be thoroughly made out true for reasons nowise to be understood."	"Accept the outrageous extravagance that a concatenation of deductions to be valid need not have meaning in every link; that a compulsory conclusion of an argument does not require intelligibility of its several steps; or that results may be thoroughly made out true for reasons nowise understood."

To us it seems well-nigh incredible that the man who made the important discovery in 1879 "that Princeton possesses * * * the identical volume from which the first translation of Euclid into English was made by Sir Henry Billingsley," and who, in 1896, "for four months * * * was buried in the uttermost parts of Hungary, Russia and Siberia," where he "made many important finds," could have failed to discover such an excellent word as 'perigon' in a book almost daily before his eyes.

BEMAN AND SMITH.

PROFESSOR JASTROW'S TEST ON DIVERSITY OF OPINION.

A DIVERSITY of answers is possible to Professor Jastrow's case of reasoning without being false in any one of them. Answers may de-

pend upon different assumptions regarding different parts of the argument.

Without going to the syllogistic part of the argument, it can be said at the outset that it is impossible to prove that *B* is *A* if *A* is *B*. Such a conclusion would violate the law of Conversion, unless the proposition *A* is *B* is a definition or exclusive. In the latter two alternatives it could be proved by the law of conversion. But Professor Jastrow gives an attempt to prove it syllogistically, that is, by *mediate* instead of *immediate* reasoning. As it is stated mediate reasoning is not applicable, because no middle term is given. Moreover, even immediate inference can do nothing until we know what kind of a proposition *A* is *B* is supposed to be. If it is the ordinary universal we cannot prove that *B* is *A*, for the reason mentioned. If it is a particular affirmative, a definition, or an exclusive proposition, it can be proved that *B* is *A* by immediate inference, and the error in the argument would be that it is an attempt at syllogistic or mediate reasoning where there is no middle term and where the attempt to supply it may be a *petitio principii*.

But, taking the syllogistic argument as it is given, it is intended as a case of prosyllogism and episyllogism connected with the disjunction that *B* is either *A* or not *A*. It is supposed, therefore, that the absurdity of the conclusion in the prosyllogism justifies the conclusion in the episyllogism, because that absurdity is assumed to show the absurdity of the first term of the disjunction, and hence the second would follow. But we must raise the question first whether the reasoning is formal or material.

In the prosyllogism the formal reasoning is perfectly correct. It is a case either of *E A E* of the First Figure or *A E E* of the Fourth Figure and is formally correct in either case. That is to say, with the premises given, the conclusion *A* is not *A* *does* follow, and there is no right to call it absurd, as Professor Jastrow does. It is an illustration of the fact that we must either impeach the premise or accept the conclusion. We cannot accept the premises and deny this conclusion at the same time. Hence, we may say either that one of the premises is a *petitio principii*, or the statement 'which is absurd' is a *petitio principii*.

There is only one way to establish a formal fallacy in this syllogism, and it is to assume that the major premises (major if the First Figure and minor if the Fourth Figure) is *O*, a particular negative. This will give *O A O* of the First Figure, or *A O O* of the Fourth Figure, in both a case of undistributed middle. But then, so far from making the conclusion absurd, as assumed here, it cannot be drawn at all. No conclusion whatever can be drawn under such conditions. Hence, if the propositions that *A* is not *A* be considered absurd it must be on other grounds than the formal reasoning, whether correct or incorrect. In fact, it is a manifest contradiction, but is not so because of the reasoning, but because the premise *B* is not *A* contradicts *A* is *B*. Technically it is the contradictory of the converse of *A* is *B*, and this makes the second premise a *contradictio in adjecto* of the first and, therefore, a *petitio principii*, a *material* fallacy.

Again, granting, on any grounds, that the conclusion of the prosyllogism is absurd, it is a *non sequitur* to infer from this fact that *B* is *A*, a *material* fallacy also. The temptation to accept it comes from the reflex influence of the assumed absurdity of the conclusion in the prosyllogism *A* is not *A*, upon the absurdity of the premise *B* is not *A*, the proposition that *A* is *B* not being questioned. But this only throws us back to a disjunctive syllogism as the only proper one in the case from which to attempt to draw the conclusion *B* is *A*, and thus nullifies the whole syllogistic procedure in the prosyllogism, as an *ignoratio elenchi*. The argument should proceed disjunctively, with the proposition *B* is not *A* as the minor premise of a disjunctive syllogism, and it would appear as follows:

B is either *A* or not *A*.
B is not *A*
$\therefore$ *B* is *A*.

But in this reasoning we have a violation of the principle in disjunctive reasoning; namely, the *modus tollendo ponens*. If we deny one term we must affirm the other. We deny the first term in the minor premise, and, as the second term is 'not *A*' (instead of *A*), when we affirm it, the conclusion must be *B* is not *A*, the same

as the minor premise, of course. But *B* is *A* is a *non sequitur*, both a formal and a material fallacy in the case. In fact, the instance is simply the common one for puzzling school boys.

It either rains or it does not rain.
It rains
∴ It does not rain.

The illusion is created by the failure to see that the principle of disjunction is not fulfilled by merely using the word 'not' before rains in the conclusion, when an additional negative is required by the dictum of this form of reasoning. The 'not' in this case is a part of the second term in the disjunction 'not rains,' and hence, when we follow the law of disjunctive inference, we should get 'It does not not rain,' or by double negatives 'It rains,' which is the true conclusion. So in Professor Jastrow's case. The *modus tollendo ponens* requires us to affirm the second term, which is 'not *A*,' and we get as the true conclusion *B* is not *A*, instead of *B* is *A*, which is a *nonsequitur*, as indicated.

But now, that I find that the conclusion is the same as the minor premise in the disjunctive reasoning, I may raise the further question whether there is not another material fallacy somewhere, since disjunctively I might get *B* is not *A*. In the instance before us this can be done, and in disjunctive inference the only fallacy that is most likely to occur is the *petitio principii*. The *non sequitur* will occur only when there is also a formal fallacy in it. Now, after assuming that *A* is *B*, it violates conversion to suppose that *B* is *A*, and it is a contradiction to suppose that *B* is not *A*. Hence with *A* is *B* as our premise, and *B* is either *A* or not *A* as the other; we have a *petitio principii* in the latter case. We might say that the disjunction is incomplete, which is possible if we assume that *A* is *B*, and which would only result in making the third alternative a particular proposition, *I* or *O*, with the formal fallacy mentioned in the prosyllogism, a *petitio principii* in the disjunctive syllogism, and a *non sequitur* in supposing that *B* is *A*.

JAMES H. HYSLOP.

COLUMBIA UNIVERSITY,
NEW YORK, January 15, 1897.

SCIENTIFIC LITERATURE.

Higher Mathematics. A text-book for classical and engineering colleges. Edited by MANSFIELD MERRIMAN, Professor of Civil Engineering in Lehigh University, and ROBERT S. WOODWARD, Professor of Mechanics in Columbia University. New York, John Wiley & Sons. 1896. 8vo. Pp. xi+576.

The appearance of this rather unique volume is significant as a proof of the rapid development of mathematical instruction in this country. It is designed for undergraduates who have mastered the elements of the differential and integral calculus. After referring to the danger of excessive specialization and to the desirability of guiding the student to 'a comprehensive view of the mathematics of the present day,' the preface sets forth the general scope of this work in the following passage, which, for several reasons, is worth quoting in full: "During the past twenty years a marked change of opinion has occurred as to the aims and methods of mathematical instruction. The old ideas that mathematical studies should be pursued to discipline the mind, and that such studies were ended when an elementary course in the calculus had been covered, have for the most part disappeared. In our best classical and engineering colleges the elementary course in calculus is now given in the sophomore year, while lectures and seminary work in pure mathematics are continued during the junior and senior years. It is with the hope of meeting the existing demand for a suitable text to be used in such upper-class work that the editors enlisted the cooperation of the authors in the task of bringing together the chapters of the book." The following synopsis of the chapters will give some idea of the contents of 'Higher Mathematics:' I. 'The solution of equations,' by Mansfield Merriman (32 pp.); II. 'Determinants,' by Lænas Gifford Weld (37 pp.); III. 'Projective geometry,' by George Bruce Halsted (37 pp.); IV. 'Hyperbolic functions,' by James McMahon (62 pp.); V. 'Harmonic functions,' by William E. Byerly (57 pp.); VI. 'Functions of a complex variable,' by Thomas S. Fiske (77 pp.); VII. 'Differential equations,' by W. Woolsey Johnson (71 pp.); VIII. 'Grassmann's space analysis,' by Edward W.

Hyde (51 pp.); IX. 'Vector analysis and quaternions,' by Alexander Macfarlane (42 pp.); X. 'Probability and theory of errors,' by Robert S. Woodward (40 pp.); XI. 'History of modern mathematics,' by David Eugene Smith (63 pp.).

That this collection of comparatively brief and disconnected chapters, however well they may be written, could be used successfully as a text-book may appear doubtful. Most of the chapters are too short to serve as a satisfactory text for a college course. Nevertheless, the work is an exceedingly valuable one. The advantage to be gained by putting into the hands of the student a work covering so wide a range, in a form so attractive and easily accessible even without the assistance of a teacher, can hardly be overestimated. Both as an incentive to further study and as a book of reference, the volume will be of great service.

The proper selection and apportionment of subjects for such a general introduction to higher mathematics is a matter of great difficulty; on the whole, the selection has been made with excellent judgment. It is certainly to be regretted that the proposed chapter on elliptic functions had to be omitted; the subjects treated in chapters I., II., IV., VIII. and IX. would have been missed far less. Modern analytic geometry, the theory of substitutions and groups with its applications, non-Euclidean geometry, quantics and theoretical mechanics were probably excluded as too advanced or as not allowing of brief presentation.

From the point of view of pure mathematics the most interesting chapters in the book are Professor Fiske's 'Functions of a Complex Variable' and Professor Halsted's 'Projective Geometry.' The geometric mode of treatment which characterizes the first third of Professor Fiske's chapter will arouse the interest and self-activity of the student and thus prepare him for the more arduous analytical investigation of the critical points of the simplest monogenic functions which occupies the remainder of the chapter. The whole is written with the greatest care, and although this is the longest chapter in the book one cannot help regretting that it is not longer. In but one or two cases conciseness seems to be carried so far as to endanger clearness—for instance, in the definition of uniform convergence (p. 274); but in general the presentation is as clear as it is precise.

Professor Halsted gives us a carefully worked-out exposition of von Staudt's system of synthetic geometry. The logical development, as was to be expected, is admirable; the form of presentation is exceedingly concise and neat. A mathematician familiar with the subject and with von Staudt's terminology may read this chapter with pleasure. But the beginner, for whom this volume is intended, will be sorely perplexed. Even if he has energy and patience enough to learn the new language here spoken, and comes to understand such phrases as "A tetrastim with dots in a conic has each pair of codots costraight with a pair of fanpoints of the tetragram of tangents at the dots" (Art. 91, p. 85), or "Two correlated polystims whose paired dots and codots have their joins copunctal are called 'coplanar'" (Art. 51, p. 76), of what use is this to him? Few persons will understand him, and he himself will be unable to understand the masters who have written, and are still writing, on the science of projective geometry. But, even apart from this passion for coining new words, it seems to the writer that the rigid formality and exclusiveness of the treatment here adopted tends to make a naturally easy and attractive subject unnecessarily difficult and almost forbidding to the beginner, and to give him a one-sided idea of what is now meant by projective geometry. To mention a minor point, a reference to von Staudt's 'Geometrie der Lage,' which, by a curious oversight, is nowhere mentioned, would have been in place in connection with the 'fundamental theorem' of Art. 59 (p. 77), which corresponds to von Staudt's Art. 88. The printer is probably responsible for assigning Pappus to the age of Plato (p. 104).

To the student of applied mathematics the chapters on 'Harmonic Functions' and on 'Probability and Theory of Errors' will prove of most value. The first half of Professor Woodward's chapter treats of the theory of probability proper, beginning with permutations and leading up to Bernoulli's theorem; the latter half, on 'laws of error,' is particularly valuable as embodying the results

of the author's own investigations on the errors of interpolated values. This chapter will form an excellent supplement to a course on the method of least squares.

Professor Byerly's chapter on harmonic functions is a model of clear and attractive exposition, in a subject by no means easy of approach to the beginner. It is, of course, largely based on the author's more extensive text-book. After showing on three particular examples how the attempt to solve certain physical problems naturally leads to Fourier series, to zonal and cylindrical harmonics, the author discusses each of these three subjects in some detail, illustrating every method by numerical examples, some of which are worked out even to the arrangement of the logarithmic work. Nothing could be more useful to the student of applied mathematics, while the pure mathematician may regret that the constant occupation with methods of solving certain problems leaves no room for inquiring into the real nature and characteristics of the functions under discussion. But, in a brief chapter, more than is here given could hardly be expected.

The introduction of numerous applications and exercises, which is a general feature of this volume, is also very prominent in Professor McMahon's chapter on hyperbolic functions. This chapter is perhaps more complete in itself than any other chapter in the book. It gives a very satisfactory exposition of the theory, with graphical representations, seven pages of tables and well-chosen applied problems.

Professor Johnson's excellent chapter on differential equations is naturally one of the longest in the book and also attains a certain degree of completeness.

On the other hand, Professor Merriman's chapter on 'the solution of equations' appears rather meagre, perhaps, because the author, as one of the editors, felt bound to keep strictly within the prescribed limits of space. A somewhat remarkable statement about the impossibility of the algebraic solution of the general quintic appears at the bottom of p. 22. After referring briefly to the researches of Abel and Galois, the author says: "Although these discussions are complex and not devoid of doubt," [a foot-note gives an inaccurate reference to Kronecker and a reference to Cockle), "they have been generally accepted as conclusive. Moreover, the fact that the quintic is still unsolved, in spite of the enormous amount of work done upon it during the past two centuries, is strong evidence that the problem is an impossible one." Comment is unnecessary.

The chapter on determinants contains more than might be expected from its brevity. Professor Weld's modesty in not referring anywhere to his text-book on the subject is worthy of mention.

The geometrical calculus is represented by two interesting chapters. The elements of Grassmann's methods as applied to plane and solid geometry are set forth at some length by Professor Hyde, while Professor Macfarlane treats of vector addition and multiplication, with particular reference to their application in mathematical physics. The quaternion proper, although it figures in the title of Chapter IX., receives but slight attention. Both chapters are far too brief to show the real power of these methods, which appears especially when geometrical differentiation and integration are introduced. The present writer cannot help regretting that Professor Hyde has not adopted the remarkably elegant and simple treatment of Grassmann's fundamental ideas proposed by Peano. From the point of view of pure mathematics Peano's method of laying the foundation for a geometrical calculus can hardly be improved upon. The physicist, however, will probably, for some time to come, prefer to become acquainted with vector analysis in close connection with the development of his physical and mechanical notions, in a manner similar to that pursued by Oliver Heaviside in his 'Electro-magnetic Theory,' Vol. I. (1893). Fortunately, Professor Macfarlane's methods and notations do not seem to differ now very much from Mr. Heaviside's. The peculiarly cumbrous notation for what might be called the polar coordinates of a vector is an exception.

In the last chapter Professor D. E. Smith gives a rapid survey of the historical development of the various branches of mathematics during the nineteenth century. This rather difficult task seems to be accomplished in a very satisfactory way, the chapter being evidently

based upon the best sources and made with great care. The chapter adds much to the value of this volume as a book of reference.

ALEXANDER ZIWET.
UNIVERSITY OF MICHIGAN.

The Development of the Periodic Law. By F. P. VENABLE, Ph. D., Professor in the University of North Carolina. Easton, Pa., Chemical Publishing Company. 1896. Pp. viii+321. Price, $2.50.

The purpose of this book cannot be better given than in the author's own words: "This work * * * is to be used for purposes of reference and of study, and not as a mere history of the subject. The errors and repetitions of the writers upon this subject in the past few years have abundantly proved the necessity for some such gathering and systematizing the work of former years."

Professor Venable's work in writing his recently published History of Chemistry has given him an excellent preparation for the critical study of the discovery and development of the periodic law, which is given in this volume. As stated by the author, much of the literature of the subject is in hidden and out-of-the-way places and a very real service is rendered to chemical science in thus coordinating it and making it more easily accessible. The scope of the book includes an account of the numerous attempts which have been made to discover numerical and other relations between the atomic weights and also an account of speculations as to the origin of the elements and their relation to some fundamental form of matter.

Calculations and speculations of this kind have had a fatal fascination for a great many chemists, and as we look over the literature and see how much has been written that is fanciful, and how much that in the light of better knowledge has been found erroneous and worthless, we are almost tempted to turn from the whole subject in disgust. And there is no doubt that many of these speculations have been worthless and the time of their authors has been nearly or quite wasted, for they have led to no accepted conclusions and they have given no incentive to useful work. But the periodic system stands on quite a different plane, for it furnishes us the best means at present available for coordinating our knowledge of the chemical elements, and it has furnished the incentive for a large amount of most excellent experimental work. That there are some imperfections in the system and that it does not, at present, give any accurate mathematical expression for our chemical knowledge must be admitted. It is tantalizing in its suggestiveness, and most chemists believe that it half reveals facts which will be of profound importance when fully understood. If the present work turns the attention of chemists in that direction it may prove very useful.

A quite full bibliography and an excellent index add to the usefulness of the work.

W. A. N.

Notes on Qualitative Analysis, arranged for the use of students of the Rensselaer Polytechnic Institute. By W. P. MASON, Professor of Chemistry. Third Edition. Easton, Pa., Chemical Publishing Company. 1896. Pp. 56. Price, 80 cents.

This book gives a concise statement of the more important qualitative tests for metals and acids, those for the metals being arranged in the order of Fresenius. Then follow tables for analysis of metals, and five pages giving very short directions for the analysis of alloys, insoluble substances and alkaline solutions.

The selection of tests is satisfactory and the book will, doubtless, furnish a basis for a good short course in the subject. It would seem, however, that even an elementary work should give directions which are reliable for cases of very common occurrence. For instance, ammonia often fails to separate small quantities of silver chloride from mercurous chloride; and ammonia will not separate zinc from chromium unless the zinc is in excess. Neither case is provided for in the directions given.

Books of this character may furnish students with excellent drill in scientific methods of work and, in the hands of a good teacher, are satisfactory from that standpoint, but the student should understand that he is liable to fall into very serious mistakes if he attempts to use the directions for practical work.

The references to Watts' dictionary and the

chemical journals form an excellent feature of the book. The habit of going to proper sources for fuller information cannot be formed too early and is of fundamental importance to any one hoping to do scientific work.

W. A. N.

A Manual of Quantitative Chemical Analysis, for the use of Students. By FREDERICK A. CAIRNS, A. M., Late Instructor in Analytical Chemistry in School of Mines, Columbia College. Third edition. Revised and Enlarged by ELWYN WALLER, Ph.D., formerly Professor of Analytical Chemistry in School of Mines, Columbia College. New York, Henry Holt & Co. 1896. Pp. xii+417.

This work was first published in 1880. In the thorough revision, which has become necessary, a considerable portion has been rewritten and additional chapters have been inserted, while the portion upon organic proximate analysis has been omitted.

The book is evidently intended for use in training those who intend to use their knowledge of analytical chemistry along commercial lines. After an introduction of twenty-two pages, ten chapters are given which contain directions for the complete analysis of a series of pure salts, including directions for the determination of seventeen elements. Then follows the main portion of the book, with chapters giving detailed directions for the analysis of limestones, clay, ores, metals and alloys as found in commerce, potable and mineral waters, acids and alkalies, bleaching powder, fertilizers, coal and commercial nitrates.

The selection of topics is such as to meet very satisfactorily the need of the practical chemist, and the directions given are clear and sufficiently full for beginners. The appendix, by Professor Waller, giving the properties of precipitates is an especially valuable feature of the book.

It would be impossible for any one to write a book covering such an multitude of details as are required in quantitative analysis and give directions which accord, in every case, with the best knowledge of the subject. Two cases which may be criticized on this ground are worthy of notice because of their importance. Gladding has shown (J. Am. Ch. Soc., 17, 898) that barium chloride should be added very slowly to secure a pure precipitate of barium sulphate, and Jannasch and Richards (J. Prak. Ch., 39, 321) and Schneider (Z. f. Phys. Ch., 10, 425) have shown that the barium sulphate precipitated in presence of ferric salts contains ferric sulphate, which loses sulphuric acid on ignition and renders a subsequent purification by fusion inaccurate. The other case is that of the Lindo-Gladding method for the determination of potassium. It has been shown that the method is inaccurate because the potassium of the chloro-platinate is partly replaced by ammonium on washing with ammoniums chloride.

Since Ostwald has pointed out so clearly the value of the new theories of physical chemistry for the practical discussion of many topics in analytical chemistry, it is to be hoped that some discussion of that sort may soon find its way into our text-books. The present book is neither better nor worse than others in that regard.

W. A. N.

SCIENTIFIC JOURNALS.

THE AUK, JANUARY, 1897.

THE number contains articles of varied interest. Mr. E. W. Nelson describes some forty new species and subspecies and one new genus of birds from Mexico and Guatemala, collected by himself and Mr. E. A. Goldman during explorations conducted for the Biological Survey of the United States Department of Agriculture during the last five years. These collections include between four and five thousand specimens, many of them collected in districts never before visited by an ornithologist. Dr. A. P. Chadbourne concludes his paper, begun in the October number, on 'Evidence suggestive of the Occurrence of Individual Dichromatism in *Megascops asio*.' This paper is illustrated with a colored plate. Two captive individuals of this species, fed on an exclusive diet of liver, were observed to change from the gray to the red phase without any evidence of molting. Other technical papers treat of various questions of nomenclature and include descriptions of a new subspecies each of the Yellow and Black-throated Blue Warblers.

Papers of a more popular character include 'Notes on a Captive Hermit Thrush,' by Daniel E. Owen; 'Recent Investigations of the Food of European Birds,' by F. E. L. Beal; 'Some Notes on the Nesting Habits of the White-tailed Kite,' by Chester Barlow; 'Report of the A. O. U. Committee on Protection of North American Birds,' by William Dutcher, and an account of the 'Fourteenth Congress of the American Ornithologists' Union,' by the Secretary, John H. Sage. Mr. Owen's experiments with the Hermit Thrush go to show that its digestion is extremely active, blueberries being found to traverse the digestive tract in one hour and a-half; also that its capacity for food was enormous, it being capable of digesting its own weight of raw meat daily. The report of the Committee on Bird Protection shows that much work is being done in behalf of the preservation of wild birds, with, in many cases, highly encouraging results. The protection of the colonies of Terns at Muskeget Island, Massachusetts, and Great Gull Island, New York, has been continued, and both colonies give evidence of considerable increase.

Under 'General Notes' is the usual variety of short communications giving items of interest respecting various rare species or the capture of species at unusual localities; under 'Recent Literature' a dozen pages are devoted to reviews of recent ornithological publications. The number closes with the 'Eighth Supplement to the American Ornithologists' Union Check List of North American Birds,' occupying twenty pages, and adding several newly recognized genera and subgenera and some twenty species and subspecies to the Check List. Also two subgenera are raised to the rank of genera, and three generic names are changed, involving changes in the names of nine species; while the names of twenty other species and subspecies are also changed, mainly through the discovery of earlier names than those previously adopted in the Check List. The additions and mutations thus number nearly seventy. Besides this, six recently described species and subspecies, and nine proposed changes of nomenclature, are treated as not entitled to adoption; while nearly a dozen other cases are deferred for final action later. Thus, within the two years that have elapsed since the publication of the Seventh Supplement to the Check List, it appears that nearly one hundred cases have arisen requiring action by the A. O. U. Committee on Nomenclature; showing, for one thing at least, no lack of activity on the part of workers in North American ornithology.

JOURNAL OF GEOLOGY, JANUARY–FEBRUARY, 1897.

Comparison of the Carboniferous and Permian Formations of Nebraska and Kansas: By Charles S. Prosser. The classification of the Carboniferous and Permian worked out in Kansas by the author is extended to cover the corresponding beds of Nebraska. In this opening paper the details of the formations as they occur in Nemaha, Johnson, Gage and Otoe counties are given, with many facts of historical and local interest.

Evidences of Recent Elevation of the Southern Coast of Baffin Land: By Thomas L. Watson. The author, a member of the Cornell Greenland expedition, concludes: (1) There is conclusive evidence of a recent elevation of 270 to 300 feet along the south and southeast coast of Baffin Land, as indicated by raised beaches, differential weathering and remains of living genera and species in beds associated with the beaches. The movement seems not to have been everywhere alike, but was only in part slow and gradual. (2) Conditions strongly favor a permanent movement on Big Island and in Cumberland Sound. (3) The Baffin Land uplift was probably coextensive with that described by Bell and Tyrrell in the Hudson Bay region. The paper includes a partial bibliography.

Italian Petrological Sketches, III: By Henry S. Washington. The author continues his discussion of Italian volcanics, treating the Bracciano, Cerveteri and Tolfa regions. Tosconite, an acid effusive characterized mineralogically by the presence of basic plagioclase as well as orthoclase with occasional quartz and chemically by high silica and alkalies and (for the acidity) high lime and low alumina, is defined. The rock is the equivalent of Brogger's quartz-trachyte-andesite and approaches his dellenite. The accompanying rocks are described

in detail and the paper includes seven excellent analyses.

Mode of Formation of Till as Illustrated by the Kansan Drift of Northern Illinois: by OSCAR H. HERSHEY. The following stages are distinguished: (1) The residuary clay is crushed and kneaded, perhaps moved a short distance, but remains free from foreign material. (2) The process is continued, foreign material is added, and there is greater, probably sub-glacial, transformation. This is believed to be represented by most of the till of Stephenson County. (3) Calcareous material is deposited in the till from solution. (4). The horizontal rock caps of the preglacial hills are pushed forward and titled. (5) These rock masses become fractured and are rolled and kneaded together. (6) By a continuation of the process a very stony till relatively free from foreign rocks is formed. (7) The angular limestone débris becomes commingled with 10 per cent. to 50 per cent. of rounded Canadian pebbles. (8) The red clay, stage 2, may become mixed with the angular limestone, stage 6. (9) Preglacial and marginal lake-bed silts become mixed with the till forming the yellow clay frequently considered to be englacial. Deposition is considered to be largely marginal and mainly subglacial.

The Geology of the San Francisco Peninsula: by HAROLD W. FAIRBANKS. Lawson's* report upon the geology of the peninsula is criticised, the author taking exception to the use of the term chert and the reference to the siliceous bands in the foraminiferal limestone as veins. He dissents from the reference of the origin of the jaspers to siliceous springs on the bottom of the ocean and urges that they were formed from radiolarian and other siliceous remains dissolved in sea water. The 'silica-carbonate sinter' deposits are held to be of recent origin and hence of no value as a base for the correlation of the Knoxville and Franciscan series (Golden Gate Series of Fairbank). It is believed that Professor Lawson has unduly minimized the importance of the disturbances which the older uncrystalline rocks show. Attention is called to the absence of any new evidence for continuing to place the Series in the Cretaceous, and the use of the term laccolith in describing the intrusives is deplored. The granite of the Golden Gate Series is held to be older than those of the Sierra Nevada rather than of the same age. H. F. B.

* Fifteenth Ann. Rept., U. S. Geol. Surv., pp. 405–476.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.—SUB-SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

THE Academy met at Columbia University on Monday evening, January 25th, with President Stevenson in the chair. The Sub-section of Anthropology and Psychology immediately organized under the chairmanship of Professor F. H. Giddings and proceeded to the regular program, which consisted of reports upon the winter meetings of the various scientific associations represented in the Section. The first report was by Professor Giddings, upon the meeting of the American Economic Association in Baltimore. The speaker paid particular attention to the presidential address of Professor Henry C. Adams, on 'The Relation of Economics to Jurisprudence;' to the paper of ex-Secretary of the Treasury Charles S. Fairchild on 'What is the Present Direction of Acquisitive Investments? What are the Economic Effects of Such Investments?' and to Professor Arthur T. Hadley's paper on 'The Duty of the Government towards the Investor.'

Dr. Livingston Farrand presented brief abstracts of the more important psychological papers read at the meeting of the American Psychological Association in Boston, December 29 and 30, 1896, and was followed by Dr. Franz Boas, who spoke of the meeting of Section H (Anthropology) of the American Association for the Advancement of Science, in New York, approving the action of the Section in recommending a regular winter meeting, to be held, if possible, at the same time and place as the American Psychological Association and the American Society of Naturalists, and reviewing briefly some of the papers presented at the meeting.

Mr. Harlan I. Smith reported on the American Folk-Lore Society's meeting in New York, on December 20th, dwelling particularly on Miss Fletcher's paper, 'Certain Early Forms of Ceremonial Expression,' and on the discussion

following Dr. Brinton's and Dr. Boas' papers, as to the validity of the theory of the psychic unity of man in accounting for details of similarities in the mythologies of widely separated peoples.

LIVINGSTON FARRAND,
Secretary of Sub-Section.

TORREY BOTANICAL CLUB, TUESDAY, JANUARY 12, 1897.

THIS was the annual meeting. Six new active and two corresponding members were elected. Resolutions of sorrow were adopted regarding the death of Mr. William H. Rudkin, one of the oldest members, the discoverer of the hybrid oak *Quercus Rudkini*. Annual reports were presented by the standing committees and officers. It was resolved to print a list of the desiderata of the herbarium of plants growing within 100 miles of the city. The Treasurer reported a cash balance of $56.89 in the regular fund and $514.14 in the Buchanan fund.

The Recording Secretary, Dr. Rusby, reported an average attendance of 31 persons at the 15 meetings held during the year, two deaths, a net gain in active membership of 28, a present active membership of 219, corresponding membership 150, honorary membership 4, scientific papers presented 37, of which 22 had been published. Several hundred new species and a number of new genera had been communicated, and there had been a marked increase in the attention given to anatomical and cryptogamic subjects.

The editor reported that Vol. 23 of the *Bulletin* had aggregated 548 pages and 34 full-page plates, and that two numbers of the *Memoirs*, aggregating 206 pages, had been issued. There was a cash balance from publications of $48.09 in addition to the balance already reported by the Treasurer.

The officers for 1897 were elected as follows: President, Addison Brown; Vice-Presidents, T. H. Allen, H. H. Rusby; Treasurer, Henry Ogden; Recording Secretary, Edward S. Burgess; Corresponding Secretary, John K. Small; Editor, N. L. Britton; Associate Editors, Emily L. Gregory, Arthur Hollick, Anna M. Vail, B. D. Halsted, Lucien M. Underwood; Curator, Helen M. Ingersoll; Librarian, William E. Wheelock.

The scientific programme of the evening was then taken up as follows:

By Mr. A. J. Grout, 'Notes on Some American *Brachythecia*.'

By Dr. N. L. Britton, *Linum Virginianum* and its Relatives.'

Mr. Grout compared the principles of classification employed by the two prominent bryologists, Schimper and Lindberg, and stated his reasons for preferring those of the latter to those of the former. He then exhibited and remarked upon four American species of *Brachythecium* and expressed the opinion that they represent a genus distinct from *Brachythecium*. The paper will be published in full in the *Bulletin*.

Dr. Britton illustrated the leading distinguishing characteristics between the species of *Linum*, of the *Virginianum* group, and dwelt particularly upon the claims to specific rank of *L. Virginianum medium*, Walter.

EDWARD S. BURGESS,
Secretary.

NEW BOOKS.

A Dictionary of Birds. ALFRED NEWTON, assisted by HANS GADOW. With contributions from RICHARD LYDEKKER, CHARLES S. ROY and ROBERT W. SHUFELDT. Part IV., Sheathbill-Zygodactyli. London, Adam and Charles Black; New York, The Macmillan Company. 1897. Pp. 833–1088 + viii + 124. $2.60.

Experimental Morphology. Part I., Effect of Chemical and Physical Agents upon Protoplasm. CHARLES BENEDICT DAVENPORT. New York, The Macmillan Company. 1897. Pp. xiv + 280.

Travels in West Africa, Congo Français, Corsica and Cameroons. MARY H. KINGSLEY. New York, The Macmillan Company. 1897. Pp. xvi + 743.

Elementary Geology. RALPH S. TARR. New York, The Macmillan Company. 1897. Pp. xxx + 499. $1.40.

Catalogus Mammalium. E. L. TROUESSART. Fasciculus I. Berlin, R. Friedländer & Sohn. 1897. Pp. v + 218. M. 10.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, FEBRUARY 19, 1897.

CONTENTS:

Louis Agassiz: WILLIAM JAMES.....285

On the Effects of Disease and Senility as Illustrated in the Bones and Teeth of Mammals: HARRISON ALLEN.....289

American Metrological Society.....295

The Apprenticeship Question: R. H. THURSTON.299

Henry L. Whiting: M. 300

Zoological Notes:—
The Generic Names Ictis, Arctogale and Arctogalidia: C. HART MERRIAM 302

Current Notes on Anthropology:—
The Woman Question; Ancient Man in England; The Chaco Idioms: D. G. BRINTON 302

Astronomical Notes: H. J.....303

Scientific Notes and News 303

University and Educational News.....307

Discussion and Correspondence:—
Lieutenant Peary's Expedition: GEO. H. BARTON. *Color-blindness and William Pole: A Study in Logic:* CHRISTINE LADD FRANKLIN 308

Scientific Literature:—
Non-Euclidean Geometry: A. S. HATHAWAY. *Waldo's Elementary Meteorology:* R. DEC. WARD. *Wiechmann's Lecture Notes on Theoretical Chemistry:* JAS. LEWIS HOWE. *The Argentaurum Papers:* W.....311

Scientific Journals:—
The Physical Review.....315

Societies and Academies:—
Eleventh Annual Session of the Iowa Academy of Sciences: HERBERT OSBORN. *The Scientific Association of the Johns Hopkins University:* CHAS. LANE POOR. *Biological Society of Washington:* F. A. LUCAS. *The New York Academy of Sciences—Biological Section:* C. L. BRISTOL.317

New Books.....320

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*LOUIS AGASSIZ.**

IT would be unnatural to have such an assemblage as this meet in the Museum and Faculty Room of this University and yet have no public word spoken in honor of a name which must be silently present to the minds of all our visitors.

At some near future day it is to be hoped some one of you who is well acquainted with Agassiz's scientific career will discourse here concerning it. I could not now, even if I would, speak to you of that of which you have far more intimate knowledge than I. On this social occasion it has seemed that what Agassiz stood for in the way of character and influence is the more fitting thing to commemorate, and to that agreeable task I have been called. He made an impression that was unrivalled. He left a sort of popular myth—the Agassiz legend, as one might say—behind him in the air about us; and life comes kindlier to all of us; we get more recognition from the world because we call ourselves naturalists—and that was the class to which he also belonged.

The secret of such an extraordinarily effective influence lay in the equally extraordinary mixture of the animal and social gifts, the intellectual powers and the desires and passions of the man. From his

* Words spoken at the reception of the American Society of Naturalists given by the President and Fellows of Harvard College at Cambridge on December 30, 1896.

boyhood he looked on the world as if it and he were made for each other, and on the vast diversity of living things as if he were there with authority to take mental possession of them all. His habit of collecting began in childhood, and during his long life knew no bounds save those that separate the things of nature from those of human art. Already in his student years, in spite of the most stringent poverty, his whole scheme of existence was that of one predestined to greatness, who takes that fact for granted, and stands forth immediately as a scientific leader of men.

His passion for knowing living things was combined with a rapidity of observation and a capacity to recognize them again and remember everything about them, which all his life it seemed an easy triumph and delight for him to exercise, and which never allowed him to waste a moment in doubts about the commensurability of his powers with his tasks. If ever a person lived by faith, he did. When a boy of twenty, with an allowance of two hundred and fifty dollars a year, he maintained an artist attached to his employ, a custom which never afterwards was departed from, except when he maintained two or three. He lectured from the very outset to all those who would hear him. "I feel within myself the strength of a whole generation," he wrote to his father at that time, and launched himself upon the publication of his costly 'Poissons Fossiles' with no clear vision of the quarter from whence the payment might be expected to come.

At Neuchâtel (where between the ages of twenty-five and thirty he enjoyed a stipend that varied from four hundred to six hundred dollars) he organized a regular academy of natural history, with its museum, managing by one expedient or another to employ artists, secretaries and assistants, and to keep a lithographic and printing establishment of his own employed with the work that he put forth. Fishes, fossil and living, echinoderms and glaciers, transfigured themselves under his hand, and at thirty he was already at the zenith of his reputation, recognized by all as one of those naturalists in the unlimited sense, one of those folio copies of mankind, like Linnæus and Cuvier, who aim at nothing less than an acquaintance with the whole of animated nature. His genius for classifying was simply marvellous; and, as his latest biographer says, nowhere had a single person ever given so decisive an impulse to natural history.

Such was the human being who on an October morning fifty years ago disembarked at our port, bringing his hungry heart along with him, his confidence in his destiny, and his imagination full of plans. The only particular resource he was assured of was one course of Lowell Lectures. But of one general resource he always was assured, having always counted on it and never found it to fail—and that was the good will of every fellow-creature in whose presence he could find an opportunity to describe his aims. His belief in these was so intense and unqualified that he could not conceive of others not feeling the furtherance of them to be a duty binding also upon them. *Velle non discitur*, as Seneca says,—Strength of desire must be born with a man; it can't be taught. And Agassiz came before one with such enthusiasm glowing in his countenance—such a persuasion radiating from his person that his projects were the sole things really fit to interest man as man—that he was absolutely irresistible. He came, in Byron's words, with victory beaming from his breast, and every one went down before him, some yielding him money, some time, some specimens and some labor, but all contributing their applause and their godspeed. And so, living among us from month to month and from year to year, with no relation to prudence except his

pertinacious violation of all her usual laws, he on the whole achieved the compass of his desires, studied the geology and fauna of a continent, trained a generation of zoologists, founded one of the chief museums of the world, gave a new impulse to scientific education in America, and died the idol of the public, as well as of his circle of immediate pupils and friends.

The secret of it all was that, while his scientific ideals were an integral part of his being, something that he never forgot or laid aside, so that wherever he went he came forward as 'the Professor,' and talked 'shop' to every person, young or old, great or little, learned or unlearned, with whom he was thrown, he was at the same time so commanding a presence, so curious and inquiring, so responsive and expansive, and so generous and reckless of himself and of his own, that every one said immediately, "Here is no musty *savant*, but a man, a great man, a man on the heroic scale, not to serve whom is avarice and sin." He elevated the popular notion of what a student of Nature could be. Since Benjamin Franklin we had never had among us a person of more popularly impressive type. He did not wait for students to come to him; he made inquiry for promising youthful collectors, and when he heard of one he wrote, inviting and urging him to come. Thus there is hardly one now of the American naturalists of my generation whom Agassiz did not train. Nay, more; he said to every one that a year or two of natural history, studied as he understood it, would give the best training for any kind of mental work. Sometimes he was amusingly *naïf* in this regard, as when he offered to put his whole museum at the disposition of the Emperor of Brazil if he would but come and labor there. And I well remember how certain officials of the Brazilian Empire smiled at the cordiality with which he pressed upon them a similar invitation. But it had a great effect. Natural history must, indeed, be a godlike pursuit, if such a man as this can so adore it, people said; and the very definition and meaning of the word naturalist underwent a favorable alteration in the common mind.

Certain sayings of Agassiz's, as the famous one that he 'had no time for making money,' and his habit of naming his occupation simply as that of 'teacher,' have caught the public fancy and are permanent benefactions. We all enjoy more consideration for the fact that he manifested himself here thus before us in his day.

He was a splendid example of the temperament that looks forward and not backward, and never wastes a moment in regrets for the irrevocable. I had the privilege of admission to his society during the Thayer expedition to Brazil. I well remember at night, as we all swung in our hammocks in the fairy-like moonlight, on the deck of the steamer that throbbed its way up the Amazon between the forests guarding the stream on either side, how he turned and whispered, "James, are you awake?" and continued, "*I* cannot sleep; I am too happy; I keep thinking of these glorious plans." The plans contemplated following the Amazon to its head-waters, and penetrating the Andes in Peru. And yet, when he arrived at the Peruvian frontier and learned that that county had broken into revolution, that his letters to officials would be useless, and that that part of the project must be given up, although he was indeed bitterly chagrined and excited for part of an hour, when the hour had passed over it seemed as if he had quite forgotten the disappointment, so enthusiastically was he occupied already with the new scheme substituted by his active mind.

Agassiz's influence on methods of teaching in our community was prompt and decisive—all the more so that it struck

people's imagination by its very excess. The good old way of committing printed abstractions to memory seems never to have received such a shock as it encountered at his hands. There is probably no public school teacher now in New England who will not tell you how Agassiz used to lock a student up in a room full of turtle shells, or lobster shells or oyster shells, without a book or word to help him, and not let him out till he had discovered all the truths which the objects contained. Some found the truths after weeks and months of lonely sorrow; others never found them. Those who found them were already made into naturalists thereby; the failures were blotted from the book of honor and of life. "Go to nature; take the facts into your own hands; look and see for yourself!" These were the maxims which Agassiz preached wherever he went, and their effect on pedagogy was electric. The extreme vigor of his devotion to this concrete method of learning was the natural consequence of his own peculiar type of intellect, in which the capacity for abstraction and causal reasoning and tracing chains of consequences from hypotheses was so much less developed than the genius for acquaintance with vast volumes of detail and for seizing upon analogies and relations of the more proximate and concrete kind. While on the Thayer expedition I remember that I often put questions to him about the facts of our new tropical habitat, but I doubt if he ever answered one of these questions of mine outright. He always said: "There, you see you have a definite problem; go and look and find the answer for yourself." His severity in this line was a living rebuke to all abstractionists and would-be biological philosophers. More than once have I heard him quote with deep feeling the lines from Faust:

> "Grau, theurer Freund, ist alle Theorie,
> Und grün des Lebens goldner Baum."

The only man he really loved and had use for was the man who could bring him facts. To see facts, not to argue or *raisonniren*, was what life meant for him; and I think he often positively loathed the ratiocinating type of mind. "Mr. Blank, you are *totally* uneducated!" I heard him once say to a student who proponded to him some glittering theoretic generality. And on a similar occasion he gave an admonition that must have sunk deep into the heart of him to whom it was addressed: "Mr. X., some people perhaps now consider you a bright young man; but when you are fifty years old, if they ever speak of you then, what they say will be this: 'That X.—oh, yes, I know him; he used to be a very bright young man!'" Happy is the conceited youth who at the proper moment receives such salutary cold water therapeutics as this from one who, in other respects, is a kind friend. We cannot all escape from being abstractionists. I myself, for instance, have never been able to escape; but the hours I spent with Agassiz so taught me the difference between all possible abstractionists and all livers in the light of the world's concrete fulness, that I have never been able to forget it. Both kinds of mind have their place in the infinite design, but there can be no question as to which kind lies the nearer to the divine type of thinking.

Agassiz's view of Nature was saturated with simple religious feeling, and for this deep but unconventional religiosity he found at Harvard the most sympathetic possible environment. In the fifty years that have sped since he arrived here our knowledge of Nature has penetrated into joints and recesses which his vision never pierced. The causal elements and not the totals are what we are now most passionately concerned to understand; and naked and poverty-stricken enough do the stripped-out elements and forces occasionally appear to us

to be. But the truth of things is after all their living fulness, and some day, from a more commanding point of view than was possible to any one in Agassiz's generation, our descendants, enriched with the spoils of all our analytic investigations, will get round again to that higher and simpler way of looking at Nature. Meanwhile, as we look back upon Agassiz, there floats up a breath as of life's morning, that makes the world seem young and fresh once more. May we all, and especially may those younger members of our association who never knew him, give a grateful thought to his memory as we wander through that Museum which he founded, and through this University, whose ideals he did so much to elevate and define.

WILLIAM JAMES.

HARVARD UNIVERSITY.

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*ON THE EFFECTS OF DISEASE AND SENILITY AS ILLUSTRATED IN THE BONES AND TEETH OF MAMMALS.**

I WAS very glad to respond to the invitation of your commitee to address you, for the reason that I have been for a long time interested in studying the effects of diseased action and senility, I hold that they are closely related and capable of being compared in precise ways with other morphological processes.

Am I right in assuming that to no other organization is it so appropriate to present the results of my investigation as to your own?

In a scientific sense the use of the words 'morbid' and 'pathological' cannot be sustained, for it assumes the existence of morbific principles. One might speak as reasonably of the use of the words 'dirt' or 'weeds' being warranted in treating of exact conceptions.

Disease tends to interfere with efficiency —in whole or in part—of the organism in which it is manifested. But this statement, you will observe, in no way relates to etiology. The difference between disease and senilty is apparent rather than real; for senility, like disease, is a condition tending to inefficiency. Many senile states resemble diseased states and include calcification, absorption, fatty degeneration, etc. But if these processes help the organism by preparing it for its work they cannot be called perversions, since all of them are present in early and confessedly normal states of the economy. Calcification is a normal process, whether we see it in the perpendicular plate of the ethmoid bone in the young adult or in the walls of blood vessels in the aged; absorption is a normal process, whether it is seen in the roots of the deciduous teeth in the young or in the orbito-temporal septum of the aged; fatty degeneration is a normal process, whether it takes place in the mature placenta and prepares the way to parturition or occurs in the form of an *arcus senilis*. But the results of these processes are enormously divergent, one maintaining physiological activities, the other hastening to decay and death.

Senility is of no definite period and, therefore, is without accurate limitation. The postulate that 'wear and tear' on tissues or organs which cannot be replaced occur in direct ratio to use is accepted. In low forms of life large portions of the economy, and some tissues even in the highest forms, are discarded and new ones take their place. Epithelial elements are constantly being thrown off, and in many animals teeth are lost when no longer of service and others are developed to supplant them. But in old age of high grade organisms we witness loss, rather than gain, both in organs, like the teeth and hair, and in tissues, as muscle fibres in the capillary blood vessels. So far as man is concerned, this period is, on the whole, included in the time when he is no

*A lecture delivered before the Graduate Club of the Biological Department of the University of Pennsylvania, December 7, 1896.

longer virile. I venture to call it the post-genetic period. The term senility, in addition to the usual ontogenetic sense, will be employed to express the changes that go on in a given group of animals on the decline from its acme of evolution, and attempts will be made to correlate these states with those occurring in the individual. (A. Hyatt.)

I propose to submit a number of facts which, for convenience, I have placed under the head of propositions, the number and variety of which give a clue to the intricacy of the subject.

It will be taken for granted throughout that the subject of variations of structure as usually limited has been carefully considered and set aside, for these do not invalidate any of the propositions.

I. *Reversion to lower types is sometimes witnessed in the senile human skull.*

Outside of Primates no mammal exhibits an orbitotemporal septum. In the senile human skull thinning, and often notable absorption of the septum is almost constantly exhibited.*

II. *Complex bones are sometimes analyzed in part by the manner in which absorptive processes occur in them.*

Many examples can be cited to illustrate the fact that bones originally separate tend to localize effects of diseased action even when the lines of separation between primal parts disappear. It is not expected that when the precoracoid bone of the cod is hyperostosed—a condition which has been often detected—that other portions of the suspensorium should participate. Neither do we find that when one-half of the lower jaw of a kangaroo is diseased that the other separate half should be involved. In the domestic cat the halves of the lower jaw are disposed to unite in old age, but even in this animal effects of inflammatory processes may be confined to one-half of the bone. In a specimen of an old cat in the Cornell collection the symphysis was united, the entire mentum thickened; but the right side of the jaw was without incisor teeth and was much larger and thicker than the left, which was provided with teeth.

The center for the premaxilla in the so-called superior maxilla of the human subject is sometimes absorbed after the suture lines between the bone and the maxilla proper have been obliterated.* In the malar bone of the human subject the lower half is sometimes separated from the upper by a suture. The bone when thus marked is said to be bipartite. The skull of a syphilitic subject in my possession exhibits absorption of the lower half of the left malar bone. Since the bipartite bone is exceedingly rare, it is probable that the specimen had not possessed the suture and that the absorptive process had stopped when the area corresponding to a distinct center of ossification had been covered. Even if the bone had been bipartite the circumscription of an absorptive process to an individual bone would have been none the less striking. In old age the peripheral venous openings on the bones tend to become enlarged. The arrangement of these openings sometimes defines the regions occupied by epiphyses which have long since disappeared. In the femur of the senile dog, for example, the line of separation of the distal epiphysis from the shaft is indicated by the venous foramina being enlarged on the periphery. I have never observed such disposition to manifest itself in vigorous adults.

III. *Bone processes are sometimes increased in size in senility, or appear in places where they are not seen in antecedent stages, though occurring normally in the species of related groups.*

In the aged human subject the styloid process is sometimes longer than in younger

* I described this in *Am. Journ. Med. Sci.*, 1870, 405.

* Ibid, p. 403.

adults. This is caused by ossification of the stylo-hyoid ligament, which is often represented by a separate bone in lower animals.

The domestic cat exhibits, as a rule, no tubercle on the lachrymal bone. In the senile skull of this species the tubercle is present. It is of interest to note that among the following skulls of *Felis* in the Academy of Natural Sciences, Philadelphia, and the National Museum, Washington, four only (*F. eyra* and *F. yaguarundi*, *F. catus* and *F. caracal*) exhibited the lachrymal bone as it is in the vigorous adult of *F. domesticus*. In the following species the tubercle was present, though small: *F. pardus*,* *F. rufus*, *F. canadensis*, *F. pardalis*,† *F. leo*. In the following it was large and formed precisely as in the old examples of the domestic cat, *F. caligata*, *F. onca*, *F. concolor*, *F. tigris*. Thus the form of the lachrymal bone in the old cat reverts to that of the prevalent type, not by absorption, as in Proposition I., but by the creation of a conspicuous process of bone.

The senile cat again exhibits hyperostosis of the lateral process of the frontal bone (post-orbital process) as well as of the ascending process of the malar bone. Thus these processes approach each other and indicate the tendency to union shown in related efficient forms of the clawed mammals in which such union actually takes place.

IV. *Both the upper and the lower jaws of certain mammals tend to elongate in old age.*

The animals already named possessing long jaws have the intervals between some of the premolars widened in senility. The vigorous greyhound has the third lower premolar almost in contact with the fourth, while in the jaw of an old mongrel it is widely separated therefrom. In a general way, it may be said that the last three premolars are all more widely separated from one another than in younger individuals. The cause appears to lie in the disposition for the jaw to extend forward somewhere in front of the region of the molar teeth; for the extraordinary wear that sometimes takes place between the lower canine and the upper outer incisor can be explained in no other way. In an old dog (No. 22,563, U. S. Nat. Mus.) the lower canine had pressed against the upper second and third incisors and had worn away the teeth. The permanent premolars always lie close together when recently erupted. This disposition appears to be a corollary to the law of the vertical succession of these teeth.

The large permanent teeth following the small deciduous teeth in exact infra-position compel the former to lie close together. But they tend to separate afterward, especially for the first and second to separate from the third and fourth. In the domestic cat the interval between the second and third teeth is more variable than between the others. As a rule, it is but 2 mm. in front of the third tooth, though it may be as much as 5 mm. These proportions are maintained throughout life in this species, so far as I know.

In the dog we have a much greater variety, since in the different breeds the face axis is modified. In the short-faced types the premolars retain their early crowded condition, or this may even be exaggerated; while in the long-faced types they tend to be separated, excepting the third and fourth teeth, which remain, at least in an example of the greyhound above noted, close together.

Putting aside the pug dogs and bull dogs, the variations in the intervals between the premolars are marked and appear to be independent of the relative length of the face to the brain case. In the St. Bernard the first lower premolar (counting it as a re-

* A small tubercle may occur in this species as a variation.

† Absence of tubercles may be noted as variations.

tained deciduous tooth) is nearer the canine than in any other variety. The interval between the third and fourth upper premolars is conspicuous in the rather short-faced Esquimaux dog and the St. Bernard.

Since in the domestic dog the increase in the length of the lower jaw occurs in phyllogeny (artificially in breeding) and in ontogeny the form is of exceptional value in the philosophic study of senility and diseased action. But the subject is correspondingly complex. So far as I know, no collections are available for its satisfactory study.

In old examples of *Glossophaga soricina* and *Pteropus poliocephalus* the intervals between the premolars is much greater than in younger individuals.

V. *Senile forms of one species may resemble in essential characters the typical forms of an allied species.*

The appearances forming the basis of this proposition may be found not only in aged animals, but in the vigorous stages of an allied species as well. Thus, an old example of *G. soricina* resembles the typical form of a closely allied species, *G. truei*.*

VI. *Gross variations in the forms of teeth in closely related and highly specialized animals indicate that the types have become exhausted of their capacity to precise adaptation and are degenerating. The forms that degenerated teeth assume are those that simulate senile changes in animals less highly specialized than themselves.*

One of the most familiar changes incident to long use is the wear of the teeth. It would appear that the height of the tooth is in some degree proportional to the work that is expected of it; that the crown represents the accumulation of a definite amount of material to be used up in grinding. We have often occasion to note the effects, upon the jaws themselves, of the lowering of the height of the crowns of the teeth.

The fox bats, which are frugivorous, are composed of fifteen genera. With a single exception (*Pteralopex*), they retain molars whose cusps have almost disappeared. The fact can be otherwise expressed as follows: The departure from the habit of the consumption of animal food to that of fruit leads to rather abrupt changes in the tooth form, by which the cusps are rapidly worn away, one insular genus alone maintaining its ancestral cuspidation.

In the New World fruit-eating bats we have examples of similar abrupt changes, though carried out in a less uniform manner. The forms do not constitute in themselves a family, but are grouped irregularly within the family, most of the members of which retain carnivorous habits, and at best the lines between the carnivorous and the frugivorous types are not sharply defined. In the Vampyri out of thirteen genera the molars of one genus only (*Hemiderma*) have lost their cusps, while in the Glossophagina out of six genera the teeth of one doubtful member of the group (*Phyllonycteris*) have lost their cusps. But in the Stenodermina, of thirteen genera, all the cusps have been lost, or are retained in the shape of the merest rudiments of the carnivorous plan. In two remote genera (*Cephalotes* and *Ectophylla*), one in the Old World and the other in the New, the concave depressed molar crown has been so worn away as to bring the grinding surface of the enamel cap near the alveolus and apparently to create a new *system of cusps*, as if the tooth were a slate on which had been placed a problem which demanded that an older problem previously recorded on the same surface should be removed before the terms of the newer one could be stated. In the senile form of every bunodont mammal the molar teeth tend to have the crowns diminish by wear and all traces of cuspidation to be lost. To my mind there is no difference between the loss of all cusps in the last premolar and the molars of an old dog, and the way

* Proc. U. S. National Museum, 1896, 779.

in which cusps are lost in bats in passing from an insect-eating to a fruit-eating habit. The fruit-eating bats might be called senile forms, because they lost their cusps, just as reasonably as we may use similar language in describing an old dog. Both forms exhibit degeneration effects; in one it is phyllogenetic; in the other it is ontogenetic.

VII. *Entire loss of teeth in the human subject from old age will often be followed by hyperostosis which presents three kinds nearly answering in position to the three series of teeth, the incisors, the premolars and the molars.*

The same law which created the differentiation of the teeth continues to operate after the loss of teeth. This is modified by the characters of chronic rheumatism and syphillis. The best examples in illustration of the proposition are met with in the jaws of savages.*

VIII. *The manner of obliteration of sutures in the skull of mammals may be definitive.*

The parieto-squamosal and the sphenoido-squamosal sutures rarely disappear in the human skull, no matter how old the individual. The suture last named disappears in the dog in the early stages of senility. The two forms are thus distinguished as readily as by the employment of other characters. We do not hesitate to distinguish by rates of disappearance of cranial suture lines the Ophidia from other reptilian orders.

IX. *Muscles modify the shapes of long bones in proportion to the length of time they have been exercised.*

The power of the flexor muscles of the limbs, on the whole, is greater than that of the extensors. It is the flexors that hold the extensor tendons firmly against the long bones, even, indeed, if they do not create grooves for the accommodation of their tendons. The longer the time the extensors are thus held against the bones the deeper become the grooves. Hence the relatively deep grooves on the extensor surfaces of long bones, as in the patellar notch and the grooves on the distal end of the radius, tibia and fibula in old animals. In an old cat in the collection of Professor Wilder at Cornell University the groove for the *Tibialis posticus* was converted into a bony canal.

Proposition IX. is also illustrated in the groove for the *Extensor longus pollicis* of the common brown bat (*Adelonycteris fusca*) becoming deeper in old individuals. At times the sides of the groove become enormously thickened by hyperostosis.

X. *In ontogeny a senile form of an annually recurrent structure may resemble the juvenile form and recall in phyllogeny the primitive form.*

The horn in an old specimen of *Cervus canadensis* tends to reassume the form of the spiked horn of young specimens, which at the same time recall the shape of the primitive horn in Pecora generally.

XI. *Inflammation of bone modifies the shape in places which exhibit the greatest physiological activities, and these prepare the way to senile changes in the same regions.**

The deepening of extensor muscle grooves when carried far will, we assume, develop friction and with the friction excess of heat and with the heat inflammation and resulted hyperostosis. But excess of heat may arise from undue exaltation of functions of any kind. In the following instances it has been productive of grave results from the conjunction of restrained growth force in the halves of the lower jaw and the eruption of the incisor teeth.

In the lower jaw of the domestic cat whose permanent premolars are just being erupted the symphysal articular surfaces are nearly smooth; in that of an animal

* Proc. Acad. Nat. Sci., 1893, 11.

* In studying the jaws of the domestic cat I have been struck by the frequency of effects of traumatism, especially of fractures of the teeth. It will be assumed that in the above statement all instances of disease following injuries have been excluded.

whose premolars are erupted the surfaces are uneven by the processes interlocking to fix the symphysis securely. At the same time that this change is announced the incisors are coming in place. The second tooth lies at first back of the first and third, so the alveolar region is twice as broad as when a little later all three teeth are in line. Thus great activities of the symphysal and alveolar regions are coincident. It is at this stage that the cat is prone to disease at the mentum. In forty-eight examples of adult lower jaws examined from your cabinet, thirty-three showed hyperostosis of the alveolar region for the incisors, the antero-posterior diameter being 5 mm. (a measurement twice that which is normal), with loss of at least one incisor, at a time when the sectorials were but slightly worn, while the jaw in other respects showed fully adult characters. In studying senility we are prepared to find the mentum exhibiting frequent changes from the normal. The entire region is often hyperostosed or carious; the incisors in part or entirely lost, and even the canines loosened or lifted by filling up of the bottoms of their sockets. In this manner a slightly plus physiological activity in the young has prepared the way to variation in adult life and to characteristic changes in old age. In the collection I found seven examples of these changes in very old bones. I am informed by Dr. Burk that, since the greater number of cats used for dissection are not over two years old, the number of senile examples in the collection is probably much less than would be found to be the case if data could be collated from life histories of the species secured under average circumstances.

It is impossible to say which of the characters outlined in the above propositions (save alone Prop. VI.) can be transmitted. It is safe to assert that many of them are sporadic in character, though I do not believe them to be adventitious.

As the individual nears the time of its own extinction it experiences changes in the composition of its tissues and gross variation in characters. Groups of animals which are also approaching extinction behave in a similar manner. Ontogenetic comparison in the first case should be made with the phyllogenetic comparison in the second as well as with the more efficient of their own types. The aged individuals of the domesticated Bovidæ, for example, should be compared with all the younger adult individuals of the Aurochs.*

The senile horse should, in like manner, be studied with the phyllogeny of the group to which it belongs. Since our knowledge of this is relatively precise, I have long thought the comparison would be of exceptional interest.

The difficulty in procuring material for studies in senility is very great and probably accounts for the slight attention which has been given the subject. I wish in this connection to gratefully acknowledge receipt of specimens from Professor Burt G. Wilder, Cornell University, from Dr. Charles Burk, University of Pennsylvania, and from Messrs. F. W. True and F. A. Lucas, of the U. S. National Museum. I respectfully solicit additional material from those who do not object to having their cats, dogs and other animals used for scientific study after they have ended honorable careers as household pets.

Harrison Allen.

Philadelphia, Pa.

*G. S. Miller, Jr. (Science, November 20, 1896, 744), in abridging Büchner's account of the degenerate and lingering European bison herd, speaks of the prevalence of abnormal conditions in parts of the skeleton. According to the tenets of the above essay, these conditions will yield, when studied, the best results when compared with those found in other vigorous groups of genera of the Bovidæ, as also with effects of age and disease in the life history of an individual of any one of the species.

AMERICAN METROLOGICAL SOCIETY.

AT the call of the Council the Society held its annual meeting at Columbia University on Monday, December 21, 1896, Professor Egleston presiding. The Society was officially informed by the Secretary, J. K. Rees, of the deaths of their President, Dr. B. A. Gould, of Cambridge, Mass., and of their Councillor, Professor H. A. Newton of New Haven.

The following minutes were adopted and ordered printed in the daily papers:

The American Metrological Society has heard with profound sorrow of the death of their honored President on November 26th. Dr. Gould was President of the Society from 1889 to the time of his death, succeeding the late President, F. A. P. Barnard. By his ability, learning and enthusiasm he did much to further the objects of the Society, and as a member of the National Academy of Sciences and of the International Bureau of Weights and Measures his influence in metrology was world-wide.

Of late years he was especially interested in throwing the whole strength of the Society in favor of the early adoption of the metric system. It was his earnest wish and hope that before he passed away he would see the metric system adopted by the government and the people of this country.

Professor Hubert Anson Newton, of Yale College, was a member of the American Metrological Society from its organization to the day of his death, August 12th, and was for many years a Councillor. His interest in the work of the Society was great and continuous. He was especially active and conspicuous in the agitation of thirty years ago, which resulted in the enactment of the law of 1866 legalizing the use of the metric system. He prepared the table of metric equivalents, of customary weights and measures, which was incorporated in this act, and by which the relation of fundamental units was defined. Professor Newton's high rank as a man of science, his excellent judgment, and his clear, practical insight in matters relating to administration, made him an especially valuable member of the Society.

The Treasurer reported receipts for the year 1896	$460.50
Balance from 1895	686.54
Total	$1,147.04
Expenditures for 1896	705.89
Balance on hand	$441.15

The Secretary reported on the work of the year 1896. This report showed that some 50,000 documents relating to the metric system had been sent throughout the United States.

The latest paper issued by the Society was Dr. T. C. Mendenhall's reply to Herbert Spencer. This reply was printed in the *Popular Science Monthly* for October, 1896. The Society obtained 10,000 reprints. 5,000 copies of this reprint had been ordered by the New Decimal Association of London.

Professor Rees presented his resignation as Secretary and Treasurer. He stated that he could no longer spare the time for the onerous duties connected with the two offices.

The following officers were then elected: President, T. C. Mendenhall, of Worcester, Mass. Vice-Presidents, Wolcott Gibbs, of Newport, R. I.; T. R. Pynchon, Hartford, Conn.; A. A. Michelson, Chicago, Ill.; T. Egleston, New York City; H. A. Rowland, Baltimore, Md.; J. H. Van Amringe, New York City; J. K. Rees, New York City. Treasurer and Recording Secretary, W. Le Conte Stevens, Troy, N. Y. Corresponding Secretary, O. H. Tittmann, Washington, D. C. Members of the Council, Cleveland Abbe, Washington, D. C.; R. H. Thurston, Ithaca, N. Y.; A. M. Mayer, Hoboken, N. J.; Henry Holt, New York City; Simon Newcomb, Washington, D. C.; W. F. Allen, New York City; S. P. Langley, Washington, D. C.; George Eastburn, Philadelphia, Pa.; C. A. Schott, Washington, D. C.; H. Jacoby, New York City.

On motion of Professor Van Amringe the following minute was recorded: "In yielding to the earnest request of Professor J. K. Rees to be allowed to retire from the offices of Treasurer and Recording Secretary, the Society expresses its sincere regret and its high appreciation of his laborious and effective services for fifteen years in conducting its business and in furthering the purposes for which it is organized."

Dr. Mendenhall remarked:

"Mr. Chairman: In seconding the resolution offered by Professor Van Amringe, I beg to offer very briefly my own testimony as to the great efficiency of our Secretary, who now insists upon retiring from that important office. It will be remembered that a year ago Professor Rees urged upon the Society the acceptance of his resignation, but finally yielded to the urgent desire of our lamented President, Dr. Gould, and to that of every member of the Society, that he might continue at least for another year, as it was believed that the affairs of metrological reform in this country were in rather a critical condition and no one so well as he could direct the affairs of the Society during that period. His energy and industry in the administration of the laborious duties of his office are well known to us all. The Metrological Society, although not large in numbers, is great in its performances, and we all recognize the fact that in a large measure the success of these performances is due to the Secretary. If I may be permitted to refer to this action of Professor Rees in connection with the fact that I have been by your partiality elected to the Presidency of the Society, I desire to express my personal regret that in the performance of my duties during the coming year I shall be deprived of the advice and cooperation of Professor Rees in an official capacity.

"I may be permitted to remark at this point that I fully appreciate the high honor which has been conferred upon me by your choosing me to succeed the two distinguished men who have before been Presidents of this Society, and, while fully appreciating my own inability to discharge the duties which will come to me as I would like, I at the same time wish to express the sense of loss which I feel in the resignation of Professor Rees, upon whom the most inexperienced might lean with confidence. It is a consolation for us to know, however, that we shall not in any degree lose the interest and activity of our late Secretary in his separating himself from the onerous duties of the office."

The Secretary reported that, at the Annual Convention of the Colleges and Preparatory Schools of the Middle States and Maryland, at Philadelphia, November 28, 1896, a resolution favoring the adoption of the Metric System was introduced by S. A. Farrand and was adopted with one dissenting vote. This association comprises about fifty colleges and universities and also eighty preparatory schools.

The Secretary reported that the Committee on Weights and Measures of the Boston Society of Civil Engineers had obtained the opinions of a majority of its members on the proposed action of Congress with relation to the use of the Metric System.

Postal cards reading as follows were sent to each member:

"I am———in favor of the passage by the present Congress of an Act requiring the metric weights and measures to be in use by the government departments generally by the beginning of the Twentieth Century, January 1, 1901."

"I should———be willing to have people generally of their own accord adopt metric weights and measures for their ordinary business transactions, and especially for those in which I am myself concerned, at the same time at which the government departments as a whole actually do adopt them."

The total number of cards sent out was	404
The total number of cards returned was	229
Number in favor of both clauses of the card	193
Number against both clauses of the card	21
Number for first clause and against second	2
Number against first clause and for second	11
Members in favor of a decimal system	2

The following interesting letter was read:

Picton House, Thames Ditton,
Surrey, England, December 11, 1896.

J. K. Rees, Secretary—*Dear Sir:* We beg to acknowledge your letter of the 28th ult., and are procuring a copy of the Blue Book containing the Report of the Select Committee of the House of Commons on Weights and Measures, before which evidence was given by one of our Directors, Captain H. R. Sankey,

R. E. We will send this to you as soon as possible, with the portion relating to our experience marked. Meanwhile, in case it does not reach you to be in time for use, we will state here that our reasons for adopting the *metric linear measures* were mainly two, both commercial: (1) To enable us to continue the interchangeable system, on which we work with our Continental licensees, and (2) to promote the sale of our engines in countries using the metric system.

It was considered possible that, although a specialty, the fact of our engines being figured in inches might tell against them when competing with others figured in millimetres. The results have been most satisfactory in all departments. In the drawing office it has been found that the change makes it easier to design, calculate, plot dimensions, check and read drawings. No mistakes have been made that can be traced to the change. In the works, where we chiefly work to gauges, there has been no difficulty in marking the latter, and marking off is easier. In a short time the men preferred metric measurements, and the change has involved no difficulty whatever. Trusting this may be of service to you, we are, sir,

Yours faithfully,

(Signed) WILLANS & ROBINSON.

THERE were also presented the following extracts from British Consular Reports collected by the New Decimal Association established to Promote the Adoption of a Decimal System of Weights, Measures and Coinage in the United Kingdom:

ROTTERDAM, October 22, 1894.—"The simplicity of the Decimal System is so obvious that its adoption in England cannot fail to be of great advantage to all interested in the trade with those counties where it already is in vogue."

MILAN, ITALY, October 18, 1894.—"As an engineer of some 20 years' residence upon the Continent, I have no hesitation whatever in stating that the present system of English weights and measures is detrimental to British commercial interests in countries like this, where the Decimal and Metrical System is in force.

"The sooner the Decimal System is adopted by Great Britain the more advantageous for her commercial interests when trading with the Continent in particular, as also to facilitate home calculations, especially in engineering departments, where excessive accuracy is an absolute necessity."

VARNA, October 23, 1894.—"If the quotations and specifications in Trade Lists are made out in English Standards of Weights and Measures, intending purchasers here generally throw them aside and consult others which give the required information in metres, kilogrammes, etc.

"In the Varna Trade Report for 1892 it is mentioned that it is especially in hardware and machinery that the non-adoption of the Metrical System acts most prejudicially against British manufactured goods.

"Commission agents here have repeatedly told me that though they represent British firms also they have, when a customer requires *precise* data as to the working and capabilities of a machine, to refer to some rival foreign maker's catalogue, with the result that the order is often placed with the latter.

"Not long ago a man came to me with the price list of a British machinery maker, and I converted for him the specifications into their metrical equivalents. He then said that the machine in question seemed just what he wanted, and that he would order one for trial, and give repeat orders if it turned out satisfactory. Meeting him again some time after, he told me that, although he would have preferred buying the English machine, he had imported one of German make, firstly, because he could not be bothered with recurring calculations based on an unfamiliar system, and secondly, because the measurements did not properly coincide with his existing machinery plant of Continental make."

CONSTANTINOPLE, October 22, 1894.—"There is no doubt that the complicated and puzzling system of weights and measures still obtaining in England is long out of date, and has become more and more of an anachronism as England has increased her foreign trade.

"Personally I have, during my long official career, seen so frequently the inconvenience of the old system that I have for very many years been a convert to the ideas of your Association."

ROUEN, October 24, 1894.—"Within the past 16 years I have served as H. M.'s Consul in three countries using the Metric and Decimal Systems, and I have not unfrequently had occasion to observe the maze into which an English trade prospectus or circular, if drawn up only on the British system, throws a foreigner accustomed from childhood to the perfect simplicity of the Metric System. And there is no doubt in my mind that the uncertainty and confusion thus created at times leads to the rejection by a would-be purchaser of a British manufacturer's circular or offers of sale.

"The British customs tariff is a model of brief simplicity, and yet we are often called upon to explain it. Within the past month I have been asked to explain 'what a duty of 14/6 a gallon means and what is 7/- a cwt. for dried fruit?' That is to say, what are their equivalents in metric weights and

measures and decimal currency? Foreign exporters to the United Kingdon would be thankful for a simple table of the British customs tariff in which the equivalent duties and units of Continental Metric Systems were shown in parallel columns beside our own."

FLUSHING, October 20, 1894.—"The adoption of the Metric System of Weights and Measures in Great Britain and her dependencies would, to my conviction, greatly benefit English manufacturers and tradesmen, and would certainly contribute to facilitate and extend business with this country."

MARSEILLES, October 23, 1894.—"Very often French merchants have complained of the great difficulty they had in reducing English weights or measures into those of the Metric System, and I have not the slightest doubt that if the said system was adopted in England it would greatly facilitate trade with this country."

LISBON, October 24, 1894.—"I am of opinion that our industries are materially handicapped in the competition with foreign manufacturers by the isolation of our system of weights and measures.

"The small tradesmen are, therefore, the real representatives of trade abroad, or at all events are fast becoming so. We should, therefore, cater to their requirements and cultivate their custom, for their friendship, to the full extent of the word, is of 'value' to us.

"In this regard I think I may safely say that to the tradesmen of foreign countries our system of weights and measures is a constant stumbling-block and acts as a deterrent. Not one in a thousand understands it, and rather than suffer the perplexity of it, or risk the loss that an erroneous computation would entail, pass on to our neighbors, who speak and write to him, in his native language, of Metres and Kilos. He thereby knows what he buys, knows what he has to clear through the custom house without risk of fine or forfeiture, and knows the length and cube which leaves him a profit when he sells.

"For these reasons I doubt not but that we lose in the aggregate much valuable trade."

ALGIERS, October 24, 1894.—"I have no doubt whatever that our antiquated and most irrational system has had an injurious effect wherever it has been employed."

VIENNA, October 26, 1894.—"I believe the adoption of the Metric System of Weights and Measures in Great Britain and her dependencies would highly benefit English importers and exporters."

MALAGA, October 23, 1894.—"I have heard purchasers here say that they bought German goods in preference to English ones because German merchants sent out their price lists made out with the prices in Spanish currency and weights according to the Metric System, whereas the British merchant always sent his made out according to English weights and currency.

"I consider that British trade with Spain would increase if we adopted the Metric System."

CHERBOURG, October 27, 1894.—"I am convinced that if a metrical system of measurement and a decimal system of coinage were established in England it would materially benefit British trade, especially with those countries, such as France, where those systems are adopted."

BORDEAUX, October 20, 1896.—"If the views of the New Decimal Association were adopted by the legislative authorities they would, I believe, greatly contribute towards facilitating, and consequently towards extending, British commercial relations with foreign countries."

MADRID, October 25, 1896.—"You have my sincerest sympathy in your endeavors to make the Metric System compulsory in England. The numerous advantages of such a system are obvious and, moreover, its adoption would greatly facilitate the commercial relations of Great Britain with the rest of Europe."

BERN, October 21, 1896.—"In transacting my official business I have frequently observed that the present English system of weights and measures is certainly detrimental to British trade in my consular district. I should, therefore, strongly urge and advocate the compulsory adoption of the metric weights and measures in Great Britain and Ireland."

ROSTOCK, October 20, 1896.—"I can only say that if such a measure as the metric weights and measures bill be adopted compulsorily it would be greatly beneficial to all who have to do business with Great Britain and also to all British subjects who have to do business with the Continent."

KIEL, November 12, 1896.—"The inconvenience which was felt when the change was made in this country was soon overcome and the reform met with universal appreciation."

BREST, October 19, 1896.—"The advantages of the Metric System are recognized by all, and were it adopted in England the British tradesmen would greatly benefit by it in his transactions with France, as at present a Frenchman will not take the trouble to calculate the value of English weights and measures into French equivalments; hence no business is done."

SEVILLE, October 30, 1896.—"I heartily sympathise with the objects of your association, and in many commercial reports have drawn attention to the loss of British trade through tendering in British weights and measures and in sterling."

TENERIFFE, September 10, 1896.—"The customer, instead of seeking British firms to whom to give his

orders, now has the goods of other countries brought daily and cleverly to his immediate notice, by adroit commercial travelers or by extensive catalogues, in the language which he understands, which give him every particular of the article he wants *in the weights and measures and currency of his own country*. What English firms carry a commercial enterprise to this extent? Some doubtless do; the majority do not. But these things must now be done, and many others, unless we are willing to give up without a struggle our well earned commercial and industrial supremacy."

SOFIA, October 14, 1896.—"I have several times referred, in previous reports, to the difficulties which arise to hindrance of commerce in consequence of the obstinacy of Great Britain in adhering to its antiquated system of weights and measures and money."

VERA CRUZ, December 3, 1896.—"The compulsory use of metric weights and measures with regard to British goods exported to foreign countries and their use in quotations and advertisements of such goods, in lieu of Imperial weights and measures, would greatly tend to the benefit of the British export trade."

AMOY, November 17, 1896.—"For many years I have been convinced that the introduction of the Decimal System into our weights, measures and money would effect an immense saving of labor and would vastly increase the wealth of our country, and that it would greatly facilitate the sale of our commodities to foreign countries. I am very much rejoiced that an association has been formed to educate public opinion at home as to the advantages of the Decimal System and to bring the matter to the cognizance of the government."

FOREIGN OFFICE, LONDON, November 17, 1896.—"I am directed by the Marquis of Salisbury to inform you that a dispatch has been received from Her Majesty's Agent and Consul-General at Cairo. Lord Cromer considers that a very general opinion undoubtedly exists in Egypt that British trade with that country would benefit by the adoption of the Metric System of Weights and Measures."

It was voted that the next meeting of the Society be held at such time as the Council shall direct.

THE APPRENTICESHIP QUESTION.

THE *American Machinist* has been doing a work of great interest and importance to the sociologist and the political economist, in the collection of facts relating to the apprenticeship question. Its editors have sent out to a large number of employers and managers of manufacturing establishments, and also to representative men among the trades-unions, a circular letter, calling for their experience and opinions relative to the desirability of maintaining the old methods of apprenticeship, and of thus insuring a supply of skilled labor in the coming generation. The summary of this, which is probably the first, attempt to secure reliable information at first hand, in this manner, is published in the issue of December 24th, which is substantially all devoted to the subject. It makes a mass of material which will well repay study and serious consideration.

A discussion in which this matter was made prominent took place at the Detroit Meeting of the American Society of Mechanical Engineers, which showed that the great leaders in the manufacturing industries of the country were very much alive to the importance of this question, and some interesting facts and opinions were there given, for which the transactions of that Society may be consulted. Articles appearing in the *Century Magazine* in 1893 also bear directly upon the subject. In the latter discussion, however, it is assumed that apprenticeship is abandoned, and that trade schools only can be expected to replace the older system in the supply of skilled labor. This assumption is proved to be without as much foundation as had probably been generally supposed. Of the 116 establishments contributing to this later discussion, 85 take apprentices—73 per cent. of the whole number—and 92 per cent. of these express themselves as satisfied that the system is a good one, even for our time. Forty-seven per cent. of all those taking apprentices have written agreements and contracts with them. The general trend of testimony seems to be in favor of taking a boy for a probationary period, to ascertain his capabilities and disposition, and

then, if approved, binding him by contract for a definite time, retaining a part of his wages in the earlier period to insure his remaining the full time agreed upon; one of the difficulties met with being the fact that the average boy has little idea of the binding force of a contract.

The trades-unions apparently exert no important influence either for or against the system. Where they do seek to control at all, it is by restricting the number of apprentices to that proportion which, in their opinion, will give a sufficient number without flooding the trade with unemployed young men or displacing older workmen by their youthful rivals. According to the editors of *The American Machinist*, no foundation has been by them discovered for the sweeping conclusions of the *Century* articles. In so far as the system, once universal, of taking apprenticeship has been given up, the fact is probably due, not to adverse action of trades-unions, but to the fact that modern methods of manufacturing, in many cases, do not well lend themselves to this older way of providing workmen. But "nothing like a complete or general abandonment of apprenticeship has taken place in machine shops, and apprentices can be, and are, taught the trades of machinist, molder, pattern-maker, etc., with entire success and with satisfaction to all concerned, even in shops where modern methods of working and management have been most highly developed."

One of the most important deductions from all this valuable testimony is that it is essential to success that, first of all, boys should be admitted to the privileges of apprenticeship *only* when good natural mechanics, when evidently intended by nature for the work, and when earnest and ambitious, honest and frank and reliable.

These communications and the editor's comments will well repay deliberate study.

R. H. Thurston.

HENRY L. WHITING.

Mr. Henry L. Whiting, Assistant U. S. Coast and Geodetic Survey and Chairman of the Massachusetts Topograpical Survey Commission, died at his residence in West Tisbury, Martha's Vineyard, on Thursday, February 4th, the last day of the seventy-sixth year of his life. Mr. Whiting's position as a public officer was in many ways unique; his services in the corps to which he belonged were noteworthy, and he had, in addition, filled many positions of responsibility and dignity, which came to him in recognition of his high character and professional accomplishments. A brief account of a career so remarkable will be of interest to the many who knew him, either personally or through his work, and to all who appreciate a life full of useful activities in faithful and efficient public service.

In the length of that service it is doubtful if his equal is now living. Had Mr. Whiting lived a few weeks longer he would have entered his sixtieth year of continued public service, all as an officer of the Coast and Geodetic Survey, which he entered at an early age. He served some time under Hassler, the first Superintendent, and for many years he stood alone as the only member of the corps who had served under *every* Superintendent of the Survey.

Mr. Whiting was born at Albany, New York. His father was a Judge of the Court of Common Pleas at Troy. His grandfather was William Bradford Whiting, a colonel in the Revolutionary War and a lineal descendant of Governor William Bradford, of the Plymouth Colony. One of his brothers was a classmate of General Grant at West Point and held high rank in the army at the time of his death; another was graduated at the Naval Academy, was one of Commodore Perry's officer's in the Japan Expedition, himself holding the rank of Commodore at the time of his death. Others of the family were distinguished, but Henry

Lawrence, the youngest, survived them all, except a sister, now residing in Philadelphia.

In the Coast Survey his great work was the development of the topographical operations of that bureau. He was regarded as the father of the system so long and so successfully in use, and every topographer in the service has at some time been under his direction and instruction. He did, indeed, direct at one time the main triangulation of the coast of Florida, but his tastes and instincts were so strong in the direction of topography that he was at an early day given entire charge of that department of the Survey. Besides being actively engaged in field work, he continued throughout most of his life to serve as general topographical inspector.

Of the general conference of the topographers of the Survey held in Washington in 1892 he was chairman, and, although then over seventy years of age, one of its most active and useful members. By detail of the Superintendent, Professor Peirce, Mr. Whiting inaugurated the instruction in land and harbor surveys at Annapolis, and under a similar detail he served for two years as professor of topographical engineering at the Massachusetts Institute of Technology. He was consulting engineer for the Massachusetts Harbor Commission for twelve years and a member of the Commission for three years. He was actively related to and a member of other harbor surveys and commissions at various points along the New England coast. With the approval of the Superintendent he was appointed, in 1884, a member of the Massachusetts State Topographical Survey Commission, serving as chairman after the resignation of General Francis A. Walker, in 1892. In 1890 he was appointed a member of the Mississippi River Commission by President Harrison, whose grandfather's inaugural address he had heard from the east front of the Capitol while temporarily at the office of the Coast Survey after a long period of field duty. He continued to serve on this Commission until his death.

In common with a number of his colleagues in the Survey, Mr. Whiting did important service during the Civil War. Of those officers absent in the field at the time of its beginning he was the first to report in Washington for volunteer service, reaching there by way of Annapolis, after Baltimore was cut off, at the same time with the New York 7th Regiment. During the war he made many topographical surveys for military purposes. On the laying of the French cable it was on his recommendation, the question having been referred to him, that Danbury was selected as the terminal station, his excellent judgment being fully proved by the remark subsequently made by Sir Charles Hartley that it was the most successful ocean cable landing in his experience.

Personally Mr. Whiting was most agreeable and charming. He had the dignity of manners which is usually associated with 'a gentleman of the old school,' along with a simplicity of character and openness of heart that made him beloved by all who came in contact with him. He was a man of splendid physique, as his long and uninterrupted service shows, and even after passing the allotted threescore and ten he never shrank from any duty, however arduous it might be. His activity in the field ceased only with his death, and in 1894 he was, by direction of the Superintendent, in general charge of the resurveys of Boston Harbor, the field work of which was done by a half dozen of his younger colleagues.

During some months before his death the unusually excellent condition of his health and his ever youthful spirit excited comment among his friends; the end of his life had not for several years seemed more remote than on the day and within the hour

in which it came. In his nearly sixty years of continuous public service he achieved a distinction in his profession of which his corps may well be proud, and all who have enjoyed personal relations with him will hold him in loving remembrance. M.

ZOOLOGICAL NOTES.

THE GENERIC NAMES ICTIS, ARCTOGALE AND ARCTOGALIDIA.

In my Synopsis of the Weasels of North America, published in *North American Fauna*, No. 11, June, 1896, I adopted the subgenus *Ictis* of Kaup, 1829, for the ordinary weasels. This name, however, is untenable for the weasels, being antedated by *Ictis* Schinz, 1824. Schinz, in his 'Naturgeschichte und Abbildungen der Saugethiere,' published at Zurich in 1824 (p. 110), gave the name *Ictis* to the Binturong (*Ictis albifrons*), which of course renders it subsequent use for a different group impossible.

The subgenus of weasels to which I applied the name *Ictis* Kaup takes the name *Arctogale* Kaup, 1829, with *Putorius erminea* as the type species. This use of *Arctogale* by Kaup, as stated in my Synopsis of the Weasels already referred to (p. 9), precludes its subsequent use by Peters and Gray (1864), and later authors for the Palm Civets, a genus of the family *Viverridæ*, for which latter genus I propose the new name *Arctogalidia*, the type species as before being *A. trivirgata*.

C. Hart Merriam.

CURRENT NOTES ON ANTHROPOLOGY.

WOMAN IN SOCIOLOGY.

The *Revue de Sociologie* for 1896 (No. 7) has a detailed report of the 'Congrès féministe' held at Paris last summer, well worth reading by those interested in the sociological aspect of the 'woman question,' as presented by women themselves.

The crucial question of marriage was discussed amply, the general tendency being to discard it altogether in favor of free unions, which, it was argued, would generally be monogamic and lasting, in a ripened society.

The closely related question of prostitution was actively debated. Its legal regulation was condemned for many reasons, especially that men have no right to legislate as to what a woman shall do in that respect. The prevailing view was "that a woman should be absolutely free to sell herself or not, as she may choose," to quote the words of one of the (female) speakers.

Co-education proved a stumbling block, strange as that may seem to us. It was considered dangerous and likely to develop mannish women. All agreed that full civil and political rights should be given to women.

ANCIENT MAN IN ENGLAND.

The President of the Anthropological Institute of Great Britain, Mr. E. W. Brabrook, published an article in *The Archæological Journal* for September last, touching upon the antiquity of the remains of man in Kent. It will be remembered that the stone relics from the chalk plateau of that region were closely studied by the late Sir Joseph Prestwich and others. They are very rude and geologically apparently very ancient, some claiming that they must be pre-glacial. Mr. Brabrook is of opinion that whenever it was that man first discovered the art of chipping stone, it certainly originated in Kent, 'and by all that we can judge from, as early in Kent as anywhere.'

This assertion is none too bold. It does not mean that from Kent this simple art spread over the world, but that in that locality we can trace a real beginning of human culture. Whether it can be followed in an uninterrupted development down to historic times, he considers more doubtful.

THE CHACO IDIOMS.

STUDENTS of American languages are laid under further obligations to Mr. Samuel A. Lafone Quevedo by his recent publications on the Mbaya dialect, and those of the Matacos and Mataguayos. They are published in the Boletin del Instituto Geografico Argentino, Tom. XVII. The last mentioned is drawn from the vocabularies of the traveler d'Orbigny, and is prefaced with a valuable introduction. The Mbayas are the Guaycurus of the older writers.

The tribes of the Gran Chaco have remained in the utmost entanglement and doubt until the numerous and careful studies of Lafone Quevedo have enabled us to classify them with a close approach to correctness. Here, as elsewhere, when it becomes possible to compare in detail a number of tongues, we find that many of their dissimilarities disappear, and the supposed diverse stocks melt into related groups of dialects.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

ASTRONOMICAL NOTES.

WE learn from the February number of *Popular Astronomy* that Dr. See and Mr. Cogshall have discovered a number of new southern double stars at the Lowell observatory in the city of Mexico. Five objects are enumerated. Strange to say, three of these objects are bright stars with very faint companions of about the 13th magnitude, all situated at pretty nearly the same distance and position angle with respect to the principal star. The *a priori* probability of such a triple discovery is so small that we suspect the possibility of the observer's having been misled by a 'ghost.' We shall look with interest for a confirmation of these discoveries, if there is any other large telescope far enough south to examine these objects with any hope of success. Possibly the new McLean telescope, soon to be mounted at the Cape of Good Hope, will be able to show these double stars.

THE *Astronomische Nachrichten* of January 15th contains an article by Dr. F. Cohn, in which he gives a new explanation of the systematic errors of heliometer measures. It has been found by various astronomers that measures of small distances made with this instrument require positive corrections. Dr. Cohn now points out that these peculiarities can be explained if we assume that all distances, both large and small, require the same systematic correction. This idea leads to the simplest explanation of these puzzling systematic errors that we have yet seen.

IN the January 26th issue of the same journal Dr. Wilsing considers the question of the absorption of light in astronomical objectives, and shows that, if the size of objectives be continually increased, a point is soon reached where the absorption more than counterbalances the increase in the light-gathering power. If the size of the objective be increased beyond this point the quantity of light reaching the focal plane will diminish.

WE have received a Doctor's dissertation by W. Ebert, in which the author deals with the possible disruption of the Solar System by the passage through it of a star having very great velocity. He comes to the conclusion that such an event would probably not produce disturbances of any great importance, unless one of the planets should happen to lie very near the course of the passing star.

H. J.

SCIENTIFIC NOTES AND NEWS.

M. A. CHATIN has been elected President of the Paris Academy of Sciences in succession to M. A. Cornu. M. M. Cornu has been elected President of the Botanical Society of France.

M. FAYE, the eminent astronomer and meteorologist, who is now eighty-three years

of age, was elected a member of the Paris Academy of Sciences fifty years ago. This jubilee was celebrated by the Academy on January 24th, a speech being made by the President and a gold medal being presented to M. Faye. In the evening a dinner was given to M. Faye, at which he was presented with the insignia of the Grand Cross of the Legion of Honor.

THE Matteucci Medal of the Italian Society of Sciences has been awarded to Professor Rowland, in recognition of his work in spectrometry.

THE London Society of Engineers has awarded the following premiums for papers read during the year: The President's gold medal to Mr. George Thudichum for his paper on 'The Ultimate Purification of Sewage;' the 'Bessemer Premium' to Mr. D. B. Butler for his paper on 'The Effect of Admixtures of Kentish Ragstone, etc., upon Portland Cement;' the 'Rawlinson Premium' to Mr. W. G. Wales for his paper on 'Discharging and Storing Grain,' and a 'Society's Premium' to Mr. M. A. Pollard-Urquhart for his paper on 'Examples of Railway Bridges for Branch Lines.'

THE lectures at the Johns Hopkins University by Sir Archibald Geikie on the principles of geology, which we have already announced, will be given daily, beginning Wednesday, April 21st. In addition to the six lectures which compose this course, strictly intended for geologists, Sir Archibald Geikie will give one public lecture during his stay in Baltimore.

DR. ALEXANDER C. ABBOTT, professor of hygiene in the University of Pennsylvania, has been appointed chief of the bacteriological division of the Philadelphia bureau of health.

M. FILHOL has been elected a member of the section of anatomy and zoology of the Paris Academy, in the room of the late M. Sappey.

MR. MIDDLETON WAKE, the Sandars reader in bibliography at Cambridge, will deliver four lectures on 'The Invention of Printing,' with special reference to book illustration.

THE Berlin Academy of Sciences has made a grant of 600 marks to Professor H. E. Ziegler, of Freiburg, for his studies in the mechanics of development.

ACCORDING to the *British Medical Journal* the subscriptions in France and other countries for a statue to Pasteur now amount to more than £10,000. M. Paul Dubois has been selected as the sculptor, and the site for the statue will probably be the space between the Rue de Médicis and the Luxembourg Gardens. More than £20,000 has already been spent in the erection of statues of Pasteur in various parts of France.

THE city of Mexico has given the name of Pasteur to the gardens situated in front of the National School of Medicine in that city.

THE following resolutions were adopted by the staff of the United States National Museum, February 6th:

"WHEREAS, Major Charles E. Bendire, of the United States Army, Honorary Curator of the Department of Oology in the United States National Museum, has been removed by death,

"*Resolved:* That in Major Bendire's death the National Museum suffers the loss of an officer who took the keenest interest in his special branch of work; whose constant aim was to improve and develop the department under his charge; and to whose unfailing interest the present admirable condition of the oological collection is due.

"*Resolved:* That in his death the National Museum has lost a valued member of its scientific staff whose place it will be difficult to fill, and American ornithology has been robbed of one of its most earnest workers."

PROFESSOR GALILEO FERRARIS died at Rome on February 7th, aged fifty years. He was principal and professor of applied physics of the Museo Industriale of Turin and a member of the Italian Senate. He made important contributions to electrical science, especially to the phenomena of alternating currents.

WE regret to record the deaths of Professor Sätherberg, of Stockholm, the pioneer in the Swedish system of curative gymnastics, aged 84; of Dr. David Kirnaldy, an engineer, on January 25th, at the age of 76, and of Dr. Hermann von Nordlinger, formerly professor of

forestry at Tübingen, on January 19th, at the age of 79.

A RESOLUTION recently adopted by Congress provides for the distribution of the topographic maps and geologic atlases of the United States Geological Survey, to the extent of 500 of each, gratuitously among foreign governments and the departments of our own government, to literary and scientific bodies and educational institutions. The measure is designed to remedy a defect in an act passed a year ago which provides for the selling of the maps and folios at cost, with 10 per cent. added. As construed, the original act did not warrant the free distribution mentioned. The geological folios have been disposed of by sale since the first folio was issued, two years ago, but the sale of the topographic maps has only recently been begun. They are sold at 5 cents. On the back of each sheet is now printed an explanatory text, an innovation which will doubtless be of advantage.

THE Senate has passed the agricultural appropriation bill calling for $3,212,902. This is an increase of $50,200 over the bill as passed by the House, $30,000 of which is for the free distribution of seeds.

LORD LISTER, in a communication to the *British Medical Journal*, announces that he has the profound satisfaction of being able to state, on the authority of the India office, that the Bombay government intend to make use of the services of M. Yersin in the treatment of persons suffering from plague. M. Yersin is now on his way to the stricken region to give a full trial to his method, and Lord Lister has learned through another channel that before the middle of February the serum treatment will probably have begun in Bombay.

Knowledge, the English monthly journal of popular science, is publishing a series of articles on 'The Science of the Queen's Reign.' The current number contains an interesting survey of 'Sixty Years of Astronomical Research' by Miss Agnes M. Clerke. The same number includes a paper by Dr. Isaac Roberts on 'Evidence of the Evolution of Stellar Systems,' with reproductions of photographs of spiral nebulæ. Astronomy, under the direction of Mr. E. Walter Maunder, is always well represented in *Knowledge*.

SURGEON-GENERAL GEORGE M. STERNBERG will review our knowledge of 'The Malarial Parasite and other Pathogenic Protozoa' in *Appletons' Popular Science Monthly* for March, telling how they were discovered and upon what grounds they are accepted as specific infectious agents. Other articles are promised by Professor D. W. Hering on 'The Present State of our Knowledge of the X-rays' and by President Jordan on 'The Stability of Truth.'

THE following items of news are from the current number of *Nature:* At the last meeting of the Chemical Society it was announced that Mr. J. J. Tustin had made a donation of one thousand guineas to the research fund of the Society. The annual meeting of the German Botanical Association will be held this year in Frankfurt a. Main, commencing on September 22d. A botanical museum has been established at Weimar, at the sole cost of Professor Haussknecht. It is designed to be 'a Central Institution for investigations in systematic botany,' and it will be under the control of the Thuringian Botanical Union.

THE new Prussian budget includes $40,000 as the first appropriation for a chemical laboratory for the University of Berlin, the estimated cost of which is $250,000. It will be situated on the Hannover'schen Strasse and will contain tables for 275 students and a lecture room seating about 400.

THE establishment of a National Patent Museum is being urged in Great Britain. The fees received by the Patent Office are much greater than the expenses, and the government will shortly be asked to use part of the surplus for the establishment of a museum.

JOHN NICHOLAS BROWN has given to the Providence Public Library Association, for the erection of a library building in that city, the sum of $200,000.

ACCORDING to an official notification of the trustees of the 'Schwestern Fröhlich Stiftung' in Vienna, certain donations and pensions will be granted from the funds of this charity this year in accordance with the will of the testatrix, Miss Anna Fröhlich, to deserving persons of

talent who have distinguished themselves in any of the branches of science, art and literature, who may be in want of pecuniary support, either through accident, illness or infirmity consequent upon old age.

THE will of the late Professor William H. Pancoast leaves his anatomical and surgical collections and $600 per annum to the Medico-Chirurgical College of Philadelphia.

A BILL has been introduced in the Pennsylvania Legislature appropriating $25,000 to furnish test standards for the inspectors of weights, measures and scales in Philadelphia.

THE botanical department of Cornell University is in receipt of a collection of 750 specimens of the flora of the North Carolina mountain region, presented by the Biltmore Herbarium in return for a collection of Arctic plants presented by the department.

THE Royal Geographical Society gave a reception on February 8th, in Albert Hall, London, in honor of Dr. Nansen. Sir Clements Markham, the President of the Society, presided and the special gold medal of the Society was presented to Dr. Nansen. Dr. Nansen delivered a lecture describing the voyage of the Fram and his adventures, but it appears from the cable dispatches that the scientific results of the expedition were not enlarged upon. A Reuter despatch of January 29th says that during his visit to Great Britain Dr. Nansen will deliver forty-seven lectures. The explorer will then go to Germany, and at the end of March will be present at a great demonstration of the Geographical Society in Berlin, organized in his honor. It is stated that Dr. Nansen declined an offer of 100,000 marks for 100 lectures in Germany. On leaving Berlin Dr. Nansen will go to St. Petersburg, where he will have an official reception. Subsequently he will visit Paris in response to an invitation conveyed to him by the French Consul-General in Christiania, and will again be the object of an official reception. During the summer months Dr. Nansen will rest in Norway, and will superintend the erection of his new villa on the higher lands of Lysaker, Christiania Fiord, on ground originally belonging to his grandfather. Early in October, accompanied by his wife, Dr. Nansen will leave for New York in order to deliver a course of fifty lectures in various cities of the United States. Dr. Nansen has contracted with a Boston and Chicago lecturing agency for fifty lectures, but it is probable that the explorer's tour in the United States will be considerably extended.

IN addition to the methods of color photography devised by Lippmann, Ives and Joly, a new invention is claimed by MM. Chassagne and Dansac. For the present the method must be regarded as pseudo-scientific, as the process is kept secret. It has, however, been exhibited before men of science in London, and is reported in the *Society of Arts Journal* and the *Times*. The process is said to be simple and inexpensive. A negative is taken on a gelatine plate, which has been treated with a solution of certain salts (the nature of the solutions used is for the present kept). The negative is developed and fixed in the ordinary way, and when finished looks like any other negative. From it a positive is printed on sensitized paper or on a gelatine film (if a transparency is desired), plate or paper having previously been treated with the unknown solution. The positive looks exactly like an ordinary photographic print or transparency, and shows no trace of color. It is then washed over with three colored solutions, blue, green and red, and it takes up in succession the appropriate color in the appropriate parts, the combinations of the colors giving all varieties of tint. Thus, in a landscape the trees take on various hues of green, the sky becomes blue, the flowers show their proper colors, the bricks and tiles of the houses are red, and so on. In a portrait the flesh tints come out well, and the different colors of the costumes are accurately given. The general appearance of the picture is that of a colored photograph. Looked at from a distance it would be taken for one. Inspected under a high magnifying power it is seen that the colors follow the details in a manner hardly possible for hand work.

THE State Geological Survey of New Jersey has proposed a plan for draining the meadows adjacent to Jersey City. According to the report in the *Scientific American*, State Geologist Smock recently visited Holland and investigated the

vast drainage systems in that country. Engineer C. C. Vermuele has made a report stating that underlying the 27,000 acres of marsh is a mass of alluvium mixed with peat, wood and other vegetable matter, more or less decayed. The depth of this accumulation ranges generally from seven to fifteen feet. The natural level of the surface is three to four inches above mean high tide, but the whole is frequently overflowed, and such extreme tides as that of the second week of last November cover it to an average depth of eighteen inches. Lately an unhealthy and undesirable population is beginning to be crowded upon them. It is stated that of the two systems of reclamation, filling and diking, the latter is the better and, indeed, the only one feasible in this case. The area can be embanked and pumping works installed for about $1,000,000, or less than $40 per acre. The interest charges and operating expenses are estimated at $6 to $7 per acre, and it is predicted that in a few years this charge could be entirely covered by assessments on the property itself, any deficiencies in the interim being met by the surrounding districts that are benefited by the undertaking.

ACCORDING to *Natural Science* a new departure has been made this winter at the Science and Art Museum, Dublin, in a series of Museum demonstrations, undertaken by members of the staff and other helpers. Two demonstrations a week have been given through December and January, natural history alternating with art subjects. The difficulty of exhibiting small Museum specimens to a large audience led to a restriction of the number of tickets issued for each occasion to thirty, or at most fifty. It is satisfactory to record that there was a large demand for tickets, and that the audiences seemed thoroughly interested with the explanations of the objects.

THE Tree-Planting Association of New York has been incorporated, Mayor Strong being President; Cornelius B. Mitchell, Vice-President; James Macnaughtan, Treasurer, and W. A. Styles, Secretary. The Association supplies to its members the fullest information as to the kind of trees most suitable for city planting, together with the names of responsible nurserymen and the prices they charge for the completed work. Applications for membership may be made to the Tree-Planting Association office, Nos. 64 and 66 White Street.

IN the current number of the *American Naturalist*, Dr. Bessey suggests that the recent appearance of two important works on North American botany, in which the English units and measurements are less used throughout, calls attention to the need of some missionary work among American botanists. "We take part, from time to time, in the action of the American Association for the Advancement of Science, in which, in vigorous and logical sentences, we express our admiration for the metric system and our conviction that the United States Congress is derelict toward this important matter. We urge Congress to make the use of this system compulsory, and yet we go on calmly writing books in which we use the most antiquated of measuring units. Not content with using feet and inches, we express fractions of inches in lines! We vote enthusiastically that mechanics, surveyors, farmers, statisticians and schoolmasters shall use the metric system exclusively, and yet we, the botanists, who, of course, are 'the salt of the earth,' are slow in doing what we so urgently recommend others to do."

UNIVERSITY AND EDUCATIONAL NEWS.

THE last number of the *Academische Revue* contains details regarding the salaries and fees of university professors in the Prussian universities which are of interest in view of the proposed plan to equalize the salaries. Of 492 full professors in the eleven universities 40 per cent. receive less than $1,200, and 40 per cent. receive $2,000 or more in salaries. The additional amount received in fees is on the average about $400, though there are four cases in which the fees amount to $5,000 or more. The salaries of associate professors are about half those of ordinary professors.

IT is reported that Professor Munk, of Berlin, or Professor Kühne, of Heidelberg, will be appointed to the chair of physiology at Berlin, vacant by the death of Du Bois-Reymond.

IT is understood that the presidency of Washington and Lee University, Lexington,

Va., has been tendered informally to Postmaster-General William L. Wilson and that he will accept the office.

THE students of the University of Athens have again been engaged in rioting. The trouble originated in a rebuke addressed by Dr. Galvani, professor of medicine, to some students who interrupted him while he was performing a critical operation. The University was closed, but the students refused to leave the building and were blockaded in it. According to the latest reports quiet has been restored, but in the riots one student was killed and a number of persons were injured.

THE Yale *Alumni Weekly* has published figures showing the relative amount of time spent by undergraduate students of the academic departments of Yale and Harvard Universities. The percentages for the more important groups of studies are as follows:

	Yale.	Harvard.
Classics	24.2	8.7
European languages	14.5	22.8
Political science	11.2	9.9
English	10.9	16.8
History	10.4	14.3
Mathematics	9.6	4.4
Philosophy	8.9	6.1
Natural sciences	8.1	10.2

It thus appears that under the elective system at Harvard only one-third as much time is given to the classics and one-half as much time is given to mathematics as is given at Yale, where these studies are prescribed. The time taken from the classics seems to be given chiefly to modern languages, English and history, but there is a slight increase in the sciences. The same facts would be shown by a comparison of the courses now taken at Yale under a partial elective system, as compared with the courses taken ten years ago.

DISCUSSION AND CORRESPONDENCE.

LIEUTENANT PEARY'S EXPEDITION.

TO THE EDITOR OF SCIENCE: At the Washington meeting of the Geological Society of America in December, 1896, a letter from Lieutenant R. E. Peary was read, in which the writer stated that a ship would be sent to northern Greenland in the summer of 1897 for the purpose of obtaining the large meteorite there and that this ship would offer means of transportation for other parties who might like to avail themselves of the opportunity. He further stated that the coast of Greenland furnishes exceptional facilities for the study of glacial phenomena and suggested the feasibility of several parties being formed to take part in work there during next summer. After a slight discussion of the subject the following resolutions were drawn up and adopted by the Society without opposition:

"*Resolved*, That the Geological Society of America endorse Lieutenant Peary's suggestion that the coast of Greenland presents an exceptionally fine field for the investigation of glacial phenomena as well as in a more limited degree of the other natural sciences, and recommend that the various universities, colleges and other scientific organizations of the country consider the matter of cooperation with Lieutenant Peary's expedition in the summer of 1897, by sending independent parties to be placed at various localities along the Greenland coast to carry on synchronous work for a period of five or six weeks.

"*Resolved*, That the thanks of the Geological Society of America be tendered to Lieutenant Peary for having brought the matter of this form of Arctic work to the attention of the Fellows of the Society."

In the summer of 1896 two parties of six members each, one from Cornell University under the direction of Professor Ralph S. Tarr, and from Boston under the direction of Professor Alfred E. Burton, of the Massachusetts Institute of Technology, availed themselves of the means of transportation offered by the Sixth Peary Expedition to Greenland. The former party was landed in the vicinity of the Devil's Thumb, in the southern portion of Melville Bay, latitude 74° 7′. A brief statement of this work has been published in this journal by Professor Tarr*.

The latter party, of which the present writer was a member, was landed at Umanak, latitude 70° 35′, and spent five weeks in making observations upon the numerous glaciers and the marginal area of the inland ice along the region

*SCIENCE, N. S. IV., 520–523.

of the Umanak, Great and Little Karajak and Itivdliarsuk fiords. A brief statement of a portion of the work accomplished has been published by the writer*. Papers by Professor Tarr and the writers were presented at the Washington meeting of the Geological Society of America. The results of the summer's work will be published in detail at a later date. Beside the main work in glaciology, each party paid some attention to the general geology and to the fauna and flora. In addition, one member of the Boston party, Mr. G. R. Putnam, of the United States Coast and Geodetic Survey, made a valuable series of magnetic and pendulum observations.

On the voyage home the members of the various parties discussed the results of the summer's work, and all agreed with Lieutenant Peary that exceptional opportunities are offered for the study of glacial geology on the coast of Greenland, and also that this coast is easily accessible from the United States or Canada. The inland ice covers the entire continent of Greenland, except a narrow marginal area along the coast line. Its depth, according to the reports of Nansen and Peary, is sufficient to cover the highest peaks that may rise in the interior, but is so far undeterminable. The marginal uncovered area has a width varying from that of a few miles in southern Greenland and in Melville Bay to sixty or more miles in the vicinity of Disko Island and the greater Nugsuak Peninsula.

It presents a bold face of cliffs to the waters of Davis Strait and Baffin's Bay seldom below 2,000 feet in general elevation, with summits often reaching to 6,000 feet and above. Through this plateau margin numerous fiords cut backward from the sea, many of them reaching the ice front and nearly all furnishing accessible routes to it. So numerous are the fiords just south of Melville Bay that the marginal area consists almost entirely of detached islands. Those that reach the ice front are occupied by glaciers that descend from it, presenting the general features of Alpine glaciers, except that they are fed from the inland ice instead of a névé region, and presenting in addition a water front with the discharge of bergs.

* American Geologist, XVIII., 1896, 379–384.

Here, then, is presented an interesting field for study, extending over hundreds of miles, of the phenomena of the ice front as it lies upon the plateau surface between the fiords; of the marginal area of the ice itself upon which journeys of a week or ten days inland can easily be made, and of the glaciers descending from the ice margin. These latter present a multiplicity of form and variety.

The Danish government has made a general survey of the coast southward from Melville Bay, but very much remains to be done, and the whole coast is but slightly known to the English or American geologist and glacialist.

If several parties could visit Greenland next summer and carry on synchronous work a great deal might be accomplished that would be of very great value. As Cornell University and the Institute of Technology sent parties last summer, so might other universities, colleges and scientific organizations send parties in the summer of 1897. Each party could select its own location and carry on its own work entirely independent of the others. The correlation of the data obtained by the various parties would make a valuable addition to our knowledge of living ice phenomena.

Lieutenant Peary's ship will probably approach the Greenland coast near Cape Desolation, between latitude 60° and 61°. In this immediate vicinity is the Julianshaab glacier, easy of access and an interesting field for one party. Other places that can be chosen for parties are Frederickshaab, Godhaab, Sukkertoppen, Disko Bay, with the Jacobshaven and Torsukatak glaciers, Umanak Fiord, Swartenkuk Peninsula, Uppernavik Fiord, etc. Parties landed at these various places would have from at least four to six weeks for investigation during the absence of the ship farther north, those at the more southern points having a longer time. At all of these places Eskimo boats can be obtained to furnish means of transportation in the fiords, and their crews can be utilized to carry packs of provisions, clothing or camping gear when on land. Could each party be furnished with a steam or naptha launch, travel would be much more rapid and a larger extent of coast could be visited.

The important work of each party should be

the investigation of glacial phenomena both present and past. In connection with the latter especial attention should be paid to evidences of glaciation on the highest peaks and to the outermost points of land. Also attention should be paid to evidences of past subsidence or elevation of the coast. Other branches of science, however, should not be ignored. The make-up of each party should be about as follows: a glacialist, as director in charge; a general geologist; a zoologist; a botanist; a meteorologist and an ethnologist. If possible, a physician should be obtained for each party, who could also act in one of the above capacities. So far as possible each member of a party should be a trained observer. In an expedition of this kind there should be no members that are not enthusiastic in the work, and each should be prepared to make the best of the opportunities offered in the necessarily limited time. The necessary expense, considering the circumstances, is not large, and it ought to be possible for each party to have sufficient funds to allow the director to select the other members.

Finally, although one summer's observations would amply repay the time spent and expense incurred, provision could be made to secure greater results through each party arranging to have its observations carried on by parties in succeeding seasons. It seems possible now that Greenland may be visited nearly every year by expeditions from the United States; certainly the six Peary expeditions have shown this to be practicable. In such case the return of a single member of a party to the position of the preceding year would enable a valuable series of observations to be made upon the edge of the inland ice and upon the motion of the glaciers by means of datum points established by the parties. Such datum points could be so located as to be found and used by one not a member of the original party.

The writer hopes to return himself to Greenland during the coming summer and continue the observations begun by the Boston party last summer.

A word may be necessary to call attention to the summer climate of Greenland. For camping during that season there is no serious exposure involved. The very long days with the sun above or only slightly below the horizon for the full twenty-four hours prevents the temperature ever becoming very low, and the continual daylight affords facilities for work or travel at all hours.

During the last summer the Boston party encountered no serious cold, the lowest recorded with a minimum thermometer being 26° above zero, F. As far as climate is concerned there is no reason why Greenland should not be a pleasant resort for the summer.

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COLOR-BLINDNESS AND WILLIAM POLE: A STUDY IN LOGIC.

It has long been matter of common knowledge among psychologists that the color-sensations which persist, in the ordinary cases of partial color-blindness, are blue and *yellow*. This was a requisite consequence of Hering's theory and was predicted by him; it was *proved* by the first case of monocular color-blindness which was observed—that of v. Hippel in 1880—and this proof has been abundantly confirmed by the cases which have been discovered since. But the theory of Young and Helmholtz apparently required that, when two color-sensations only persisted, if one was blue the other must be either red or green. Now, the physicists (and most physiologists as well) too hastily took the Young-Helmholtz view as expressing fact and not theory, and they continued to infer (although Helmholtz himself had recognized the true state of the case) from the circumstance that the partially color-blind had two sensations only, that these sensations were, in the ordinary cases, blue and *red*, or blue and *green*; and in accordance with this deduction they classified most cases of color-blindness as red-blindness or green-blindness (without expressly stating that, in their view, in both cases, blindness to yellow was involved as well). There was absolutely no reason *except the theory* for affirming that the warm color of the defective person was either red or green; all that was known was that it occupied that portion of the spectrum which, for the normal

person, is occupied by red, yellow *and* green. Nevertheless, it is stated in twenty text-books that the sensations of the color-blind furnish exceedingly strong, if not convincing, evidence of the truth of the Young-Helmholtz theory. Moreover, the belief that the warm color is either red or green has become so ingrained that the cases by which it has been shown beyond question that it is in fact yellow have failed to produce any effect whatever. There is hardly a physicist, and there are very few physiologists, in the English-speaking world who do not still hold to this belief; as recent instances, we may cite the Century Dictionary and Johnson's Cyclopædia (both of which are, in general, of good authority in scientific matters), and the recent extensive memoir on color-blindness by Abney and Festing in the *Philosophical Transactions*. These last authors say that the examination of color-blind persons is of prime importance for testing any theory of color vision, and, nevertheless, they are content, like so many others, to *infer* the sensations of the color-blind from a theory which they have already adopted.

But as early as 1856 there was one man who, himself color-blind, had convinced himself that his own sensations were blue and yellow, and he should have convinced all the world as well if the world had been open to reason—if it had not been preoccupied with a theory. This man was William Pole, F. R. S., professor of civil engineering in University College. His papers on the subject were published in the *Philosophical Transactions;* his argument is exceedingly ingenious and it is little to the credit of the reasoning public that it did not make headway. Had it appeared a few years earlier than it did, it is probable that the Young-Helmholtz combination would never have been formed. Professor Pole preserves the interest in the theory of color visions which he felt forty years ago, and he is the one person, so far as I know, who has discussed Helmholtz's late profound mathematical contributions to the subject.

The history of opinion regarding color-blindness presents, therefore, this series of occurrences:

1. A deduction from a theory was taken for a fact.

2. That supposed fact was taken as confirming the theory.

3. The same supposed fact was held so strongly that the highly ingenious reasoning by which Professor William Pole showed it to be erroneous forty years ago failed to awaken attention.

4. Moreover, the cases of monocular color-blindness, by which it is absolutely contradicted, and which date from fifteen years ago, are without effect upon it, with most people, even at the present day.

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SCIENTIFIC LITERATURE.

Non-Euclidean Geometry, or The Science of Absolute Space. By JOHN BOLYAI. Translated from the Latin by DR. GEORGE BRUCE HALSTED. Austin, Texas, the Neomon.

This book of John Bolyai was published in an appendix to a work of his father's in 1832—within the memory of many men now living. The same date marks the publication of Faraday's experiments in the science of electricity, which revolutionized the whole theory of electricity and gave to the world the dynamo. Faraday's conception of electricity as an action that pervades all space like that of light and heat, and the later identification by Herz of all three phenomena as very probably different phases of one and the same action, is not more strange, new, or revolutionary, than Bolyai's science of absolute space. We are indebted for this English translation to the zeal, energy and ability of Dr. Halsted, who has long labored in this field of mathematics.

What is this science of absolute space? Those who wish to know in detail should get the book and read it carefully. The translator's introduction contains a complete historical summary, and the earlier portions of the work are within the comprehension of every student of elementary geometry. In general, Bolyai has shown that the geometry of Euclid is an hypothesis; that there are an infinite number of geometries equally probable with Euclid's, and that which of these coincides with the true properties of the space in which we live can be determined

only by measurements of absolute exactness. Just as we are content to accept a small piece of smooth water as level, although we know from measurements of large surfaces of it that it is curved, so we must be content to take Euclid's geometry as true within the limits of error of ordinary measurements. It may be that we shall be able to arrive at such a precision of measurement of the very large or the very small as to prove Euclid's geometry false; we can only prove it true by arriving at infinite precision of measurement, which can never be.

It is interesting to note the effect of this discovery upon the position of Euclid as a mathematician of ability. It has raised him to a position higher than it had ever been supposed possible to place him, for his work shows that he knew something of this science of absolute space—how much may never appear, but certainly enough to make him the original progenitor of it. Certain portions of Euclid have long been considered as blemishes in an otherwise remarkable book. His treatment of proportion has been discarded in modern geometries as too prolix and heavy. His treatment of parallels has been regarded as unscientific, and would-be authors, bent on showing their ingenuity and superiority to Euclid, have adopted other methods which they claimed were more satisfactory. But when a man like Bolyai appears, whose genius is comparable with that of Euclid, he brushes the dust of ages from these blots, and behold, they shine as gems of purest thought, whose brightness and depth confound and dazzle his would-be improvers! After all, it takes a long time for scientific knowledge to spread, and doubtless there will continue to be many authors who will write geometries with so-called modern improvements that proclaim simply their authors' ignorance of the elements of Euclid and the science of space.

Many editions and different points of view of Non-Euclidean gometry have been presented by modern authors, such as Cayley, Clifford, Riemann and others. Of American workers on the subject we have Dr. Halsted who has been interested on the historical side, dating probably from his Bibliography of the subject prepared for the *American Journal of Mathematics*, while a Fellow of the Johns Hopkins University. We may expect much more new and valuable material from him in this line. Dr. Story, of Clark University, has also written for the same journal in line with the labors of Cayley, Clifford and other European mathematicians. One remarkable feature of the later developments is that the various non-Euclidean geometries may be interpreted as the forms in which Euclidean geometry itself would appear, depending upon the meaning of those vexatious quantities '*distances*,' '*angular measurements*,' *etc.*

A. S. Hathaway.

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Elementary Meteorology for High Schools and Colleges. By Frank Waldo, Ph.D. New York, Cincinnati and Chicago, The American Book Company. 1896. Pp. 372.

Another *Elementary Meteorology* is added to the list of recent works under that same title. This one is by Dr. Frank Waldo, of Princeton, N. J. Dr. Waldo was formerly connected with our Signal Service (the predecessor of the present Weather Bureau) as Junior Professor of Meteorology, and in that capacity gave instruction in meteorology to the officers and men of the Service. His experience then gained, and his intimate acquaintance with the modern German writings in this science, should have qualified him well for the preparation of a text-book of meteorology. This volume is designed, as is stated on the title-page, 'for High Schools and Colleges,' and, as appears in the preface, 'is intended to serve as a text-book of the elements of the science for general students, and must not be considered as a manual for practising meteorologists.' The book will doubtless have a large sale. It gives a good general view of the science; it is of convenient size, well printed, fairly well illustrated and, a very important matter, it is published at a moderate price. The general plan of the book is similar to that of most of the other text-books, so that there is no occasion for comment on this score, but the chapter on the general circulation of the atmosphere is more complete than usual. Dr. Waldo has succeeded in putting Ferrel's ideas on this subject into tolerably simple lan-

guage, which is by no means an easy task. The last chapter, on the climate of the United States, is also quite extended, and will prove useful.

We might state our opinion of the volume in the following words: It is good, but it is not an *elementary* meteorology. Our author has succeeded in condensing a very great deal of information into his 372 pages, but for our part, we do not consider the book adapted for use in high schools. Some of the chapters can be easily understood, but certainly many of them would be difficult for anyone to appreciate thoroughly unless a pretty careful study of meteorology had preceded. Take, for instance, the chapter on the general circulation of the atmosphere, which, as already stated, is well done. We wish we could believe that our high school students, or even many of our college students, could thoroughly master that. We think our author has made a mistake in attempting to put so much information into this one volume, if his intention is to give an elementary presentation of the subject. It would be better to treat fewer matters, and to take each up at some length, than to attempt to include so many topics and necessarily dismiss many of them with a few words only. An elementary meteorology adapted to school use still remains to be written. Such a book, according to our way of thinking, should not attempt to cover nearly so much ground as has hitherto been the practice of writers of 'elementary' text-books of meteorology. It should devote far more attention to the instrumental side, to the study of weather maps, and to individual observations, both with and without instruments. Only after some such truly elementary knowledge concerning local phenomena has been gained can the student fully appreciate the larger facts which the general temperature, pressure, wind and rainfall conditions of the globe present.

What has been said regarding the non-elementary character of Dr. Waldo's book should not operate in the mind of the reader to detract from any of its merits as a text-book for the use of more advanced students. It will undoubtedly be widely read, and do a good work in disseminating sound meteorological learning.

R. DE C. WARD.

HARVARD UNIVERSITY.

Lecture Notes on Theoretical Chemistry. By FERDINAND G. WIECHMANN, Ph. D., Columbia College. Second edition. Revised and enlarged. New York, John Wiley & Sons. 1895. 8°, pp. xviii+288.

The apparently growing tendency to divorce practical and theoretical chemistry is probably unfortunate for the training of the next generation of chemists. To study chemical phenomena without studying the principles of chemistry is much like relegating the student to the days when these principles were unknown; yet, in many of our modern text-books, every effort seems made to eliminate theory, as far as possible, and carry chemistry back to where botany was a few years ago, the study of a sufficient number of plant forms to enable the student to 'analyze' a flower. True, when one has acquired a good knowledge of general chemistry by several terms of study, it is desirable to go over the theoretical ground again and more extensively than it can be done in an elementary course, and for this purpose there are a number of excellent works not only in German, but also in English, and one at least by an American. Professor Wiechmann's work, however, covers a more elementary ground and is well fitted to accompany, rather than to succeed, college work on general chemistry. While it consists of 'Lecture Notes,' it is fuller than this title would indicate and might well be called an Elementary Treatise on Theoretical Chemistry. Undoubtedly, it would be a great advantage for a student to have before him the original lectures of which this book gives the notes; nevertheless the subject is set forth so clearly that the book has an independent value even as a text-book. It would be very helpful for all teachers of chemistry in secondary schools to have a good knowledge of its contents, and would be a great advantage to their teaching.

Chapter I. treats of matter and its forms, including solutions and change of state; chapter II. of the measurement of matter and specific gravity. The various methods of taking specific gravity and density are well classified and briefly described. Chapter III., the science of chemistry, is a brief introduction. Chapter IV., on chemical nomenclature and notation, is

an excellent historical resumé, quite full and very interesting to every student. Of the next chapter, on chemical formulæ and equations, less can be said; the writing of chemical equations cannot readily be reduced to rules. Atoms, atomic mass and valence are next taken up, and well epitomized; the periodic law is then briefly described, and the author well says: "Although the periodic law cannot as yet give a logical explanation of all these phenomena, still it stands unquestioned, that it is one of the most far-reaching, if it be not the most important law of chemistry." These two chapters, which condense the whole of Lothar Meyer's Moderne Theorie der Chemie, might have been wisely expanded to several times their volume without being disproportionate to the rest of the book. Molecules, molecular mass (including osmotic pressure), and the structure of molecules follow, and then a long chapter is devoted to stoichometrical calculations. Chemical arithmetic should certainly be thoroughly studied in 'practical' chemistry, yet the very fact of its being included in this book reflects a felt need. The concluding chapters are on energy: chemical energy (in which there is an excellent summary on measurement of chemical affinity) and photo-chemistry, thermal energy and thermo-chemistry, and electrical energy and electro-chemistry. The book closes with a quite complete bibliography of over two hundred titles of works relating to the material considered in the book, more than one-half published within the last decade.

The book is very free from typographical errors as well as from errors of statement. It is unfortunate that the terms specific gravity and density of gases should be used interchangeably; specific gravity is best used for air as the standard, and density confined to those cases where the unit is hydrogen.

Jas. Lewis Howe.

Washington and Lee University.

The Argentaurum Papers. No. 1. *Some Remarks Concerning Gravitation.* Addressed to the Smithsonian Institution, the American Association for the Advancement of Science, * * * and all learned bodies. By Stephen H. Emmens, member of the American Institute of Mining Engineers, etc. The Plain Citizen Publishing Co., New York.

It is not generally worth while for any one other than a psychologist or an alienist to look beyond the title page of so pretentious a work as this first installment of the *Argentaurum Papers.* But the author of this pamphlet of 150 octavo pages has contrived to exploit himself so extensively in the advertising columns of respectable journals, including Science,* that his work demands a brief notice.

The only part of the paper of any value is the 'Envoy,' which occupies the last twenty pages and gives the author's biography along with a list of his numerous publications. From this envoy it appears that in his academic days he was a prize man in chemistry, physics, logic and other subjects; that he has published treatises on pure and applied logic, Locke on the conduct of the human understanding, the philosophy and practice of punctuation, etc.; and also that he has published 'well-received' work in the domain of fiction. We learn with regret that he is at present a paralytic. "I have for the last nineteen years been paralyzed," he says, "by an injury to my spine, and am unable to move about with freedom." This might make us charitable, but he is too vigorous and clever a paralytic to implore any lenity; for he adds, stoically, "I do not say this by way of any excuse. No physical disability is a valid apology for bad work. Cripples must not *inflict* themselves upon other people."

As to the fate of his work he is fully resigned. He says: "I am prepared to be told, in the first place, that I am ignorant and foolish; that

* The insertion in Science of an advertisement of a book which we review so unfavorably may seem to need an explanation. In the contract with The Macmillan Co. the right is given to the responsible editor to veto any advertisement, but it is not desirable to use this power unless necessary. The author of the present book is said to have done good scientific work, and it would doubtless seem to him and to others like persecution not to permit him to bring his book to the attention of men of science. It is our duty to condemn the book according to our judgment, but the history of thought demonstrates that it is wrong to suppress freedom of speech or of publication. J. McK. C.

I have ventured into a field without even a decent equipment of knowledge, and that I have altogether failed to understand the real meaning and bearing of the accepted teachings of modern science." We beg to state gently but firmly that this indictment is strictly correct in all particulars. The author of this screed on gravitation demonstrates conclusively: first, that he does not understand the fundamental concept of Newton's law of attraction; secondly, that he does not know enough of elementary mathematics to apply this law to the simple case of a homogeneous sphere; and, thirdly, that he possesses little of the caution which is born of a knowledge of things physical. He illustrates well the colossal impudence of those pseudo-scientists whose equipment consists of formal logic and a facile pen. W.

SCIENTIFIC JOURNALS.

PHYSICAL REVIEW, VOL. IV., NO. 4, JANUARY–FEBRUARY, 1897.

The Freezing Points of Dilute Aqueous Solutions, III.: By E. H. LOOMIS. This paper is devoted to a continuation of Dr. Loomis' experiments on the lowering of the freezing point by dissolved substances. The method is the same as that previously employed. In the present series of experiments the substances tested were chiefly chlorides and phosphates, though several of the more important organic acids were also used.

Since the substances employed were electrolytes, Dr. Loomis' results afford a check upon the theory of electrolytic dissociation, osmotic pressure, etc. As in the case of his earlier measurements, the agreement is entirely satisfactory only in few cases. It is well known, however, that the ordinary formula for the lowing of the freezing point depends upon several assumptions and approximations of a very doubtful character. So that it seems not improbable that the apparent discrepancies that are brought out by Dr. Loomis' measurements may lead to an improvement in the whole theory.

A Method for Energy Measurements in the Infra-red, and the Properties of the Ordinary Ray in Quartz for Waves of Great Wave-Length: By E. F. NICHOLS. This article contains two important features: first, the description of a new type of instrument for the measurement of infra-red radiation; and second, the account of measurements made with it by which the optical properties of quartz were investigated in the extreme infra-red.

The instrument used by Professor Nichols is a modified form of the Crookes radiometer. It consists essentially of two excessively small vanes mounted upon a fine quartz fibre and suspended in vacuo. The rays to be measured are allowed to fall upon one of the vanes, and a deflection of the system results. The deflection is measured by means of a light mirror. This form of instrument is found to be much more sensitive than any bolometer heretofore used. More important than its increased sensitiveness is, however, its freedom from the various disturbances to which a sensitive bolometer is subject. The radiometer does not depend in its action upon any electric or magnetic forces, and is therefore free from the irregularities which are always present when a sensitive galvanometer is used. The instrument is also capable of being more thoroughly protected against outside temperature disturbances. It can hardly be questioned that this instrument will make a considerable advance in our knowledge of infra-red spectra.

This new type of radiometer was employed in connection with a mirror spectrometer to investigate the reflection and absorption of quartz. For wave-lengths in excess of 4μ quartz becomes practically opaque with layers of ordinary thickness. To investigate the absorption a very thin layer was prepared, the thickness being not more than 18μ. Sufficient energy was transmitted through this film of quartz to be detected, and measurements of absorption were extended to about 8μ. At that point even this extremely thin layer failed to transmit a measurable amount. Numerous well-defined absorption bands were detected between 4μ and 8μ. The reflecting power of quartz was measured throughout the same range of wave-lengths by comparison with silver. Making use of the Cauchy formula, the index of refraction was then computed from the observed values of the

reflection and absorption. The results indicate distinctly the presence of anomalous dispersion, the critical wave-length being that where the absorption of the quartz becomes complete. The article is an important one in its bearing upon the theories of dispersion and absorption.

Heat Rays of Great Wave-Length: By H. RUBENS and E. F. NICHOLS. Experiments are described in this paper by which infra-red rays were detected of greater wave-length than any heretofore observed. The longest wave-lengths in the infra-red which had previously been measured were those studied by Paschen in connection with the dispersion of fluorite. These rays had a wave-length of a little less than 10 μ. Messrs. Rubens and Nichols have succeeded in obtaining and measuring rays whose length is 25 μ, these rays being obtained by successive reflection from fluorite. It appears that this substance possesses an absorption band in the neighborhood of 25 μ, which is so intense as to suggest metallic absorption. There results a great increase in the reflecting power of the material in the neighborhood of this wave-length, so that after successive reflection from three surfaces of fluorite the rays that remain are found to consist almost wholly of waves corresponding to this absorption band. The wave-length was determined by means of a wire grating. Similar experiments with quartz led to the detection of waves of about 6.5 μ. Experiments were also tried with rock salt, but the bolometer was not sufficiently sensitive to enable the resulting waves to be measured. The authors intend to continue this work, using the improved radiometer described by Professor Nichols in the previous paper.

On the Formation of Lead Sulphate in Alternating Current Electrolysis with Lead Electrodes: By S. SHELDON and M. B. WATERMAN. The work described in this paper is in part a continuation of the authors' experiments on the capacity of electrolytic condensers (*Physical Review*, II., p. 401). Attempts to find condensers of this type which should be efficient and free from 'hysteresis' led to the trial of lead electrodes in sulphuric acid. As a condenser this form of cell was no improvement over those first used. But when placed in an alternating current circuit a curious instance of alternating current electrolysis was observed, namely, the development of insoluble lead sulphate at both electrodes. Experiments were then made to determine the dependence of the amount of electrolytic action upon current density, frequency of alternation, temperature, etc. The results, both in tabular and graphic form, are contained in the present article.

Polarization and Internal Resistance of a Galvanic Cell: By B. E. MOORE and H. V. CARPENTER. This article is devoted to an experimental study of the 'diamond' carbon cell, the object of the authors being to localize the changes in polarization and resistance which occur on opening and closing the circuit. Their chief conclusions are: (1) that polarization occurs at both electrodes, but is more marked at the carbon electrode; (2) on closing the circuit the rapid fall of E. M. F. is due principally to the polarization at the carbon electrode; (3) the rapid rise in E. M. F., when a cell is first thrown upon open circuit, is largely due to recovery from polarization at the zinc electrode.

The Trace of the Gyroscopic Pendulum: By ERNEST MERRITT. In this article the motion of the gyroscopic pendulum is first briefly discussed from a theoretical standpoint. A number of photographic traces are then shown, which were made by reflecting a beam of light from a mirror attached to the lower end of the pendulum. Several different types of curves are represented corresponding to different starting conditions and to different lengths of pendulum. These curves are of interest in affording a concrete illustration and confirmation of the theory of gyroscopic motion. They also bring out a curious effect due to friction, which is exactly opposite in its result to what would be at first expected.

Note on Different Forms of the Entropy Function: By W. F. DURAND. Professor Durand discusses, in this article, the general form of the integrating factor which must be used in order that the integral of dQ shall vanish for any reversible cycle. It has generally been recognized for some time that the absolute temperature represents only one of the infinite number of possible integrating factors. If some other of these factors

were used we might get something analogous to entropy, and which, nevertheless, would possess different and possibly interesting properties. Professor Durand has discussed two special forms which the integrating factor might take for a perfect gas. One of these is where it is a function of the pressure only, and the other in which it is a function of the volume only.

Books Reviewed: Frick, Physikalische Technik; Wilkinson, Submarine Cable Laying; Griesbach, Physikalische Propadeutik; Weldon, Physical Measurements.

SOCIETIES AND ACADEMIES.

ELEVENTH ANNUAL SESSION OF THE IOWA ACADEMY OF SCIENCES.

THE Iowa Academy of Sciences held its eleventh annual session in Des Moines December 29 and 30, 1896. In the absence of the President, Professor T. P. Hall, Professor W. S. Franklin, First Vice-President, occupied the chair. The following papers were presented:

'The State Quarry Limestone,' by Professor S. Calvin, describes a series of limestone ledges of Devonian age consisting of comminuted parts of brachiopods, crinoids, etc., some of which deserve to rank as a brachiopod coquina. As now known, limited to a few local deposits in Johnson county. It appears to be unconformable on the Cedar Valley limestone and laid down after an erosion period of considerable length. No such erosion period in the Devonian has hitherto been suspected. The fauna, in some respects unique, contains a remarkable fish bed including the common Devonian type Ptyctodus, but also the Carboniferous Psephodus. Some of the brachiopods also have Carboniferous affinities. It is probable the beds represent the closing stage of the Devonian.

'Stages of the Des Moines, or chief Coal-bearing Series of Kansas and Southwest Missouri and their equivalents in Iowa,' by C. R. Keyes.

'Natural Gas in the Drift of Iowa,' by A. G. Leonard, enumerates the different localities where natural gas has been noted and relation of these to drift sheets. The gas has two possible sources, the underlying coal-measure shales and the vegetable accumulations in the drift. The latter are supposed to be the source of the natural gas in Iowa.

'Results of Recent Geological Work in Madison County,' by J. L. Tilton, included discussion of the geological formations of the county, distribution of the loess, drift and alluvium, relation of present to preglacial drainage, and other features.

'A Drift Section at Oelwein,' by G. E. Finch; 'Evidence of a sub-Aftonian Drift in Northeastern Iowa,' by S. W. Beyer, and 'The Botany of a Pre-Kansan Peat-Bed,' by T. H MacBride, all dealt with some exposures recently studied in the northeastern part of the State which are of special interest as showing very clearly a distinct separation of glacial periods, at least five of which are now known to be well marked by deposits in Iowa.

'Additional Observations on the Surface Deposits of Iowa,' by B. Shimek, detailed results of a series of borings and evidence in support of the author's view that the loess deposits in western Iowa are of æolian origin.

'The Flora of the Sioux Quartzite,' in Iowa, by B. Shimek, included an annotated list of the plants observed by the author on the quartzite exposure in Iowa, with a discussion of its relation to the remaining flora of the State.

'Notes on the Aquatic Plants of Northern Iowa,' by the same author, included mention particularly of the flowering plants occurring in lakes and ponds.

'Spermaphyta of the Fayette, Iowa, Flora,' by Bruce Fink; a list including about 700 species of plants collected at or near Fayette.

'Notes on the Flora of Iowa,' by T. Z. Fitzpatrick; a short list of species new or little known to Iowa flora.

'The Mechanism for Securing Cross-fertilization in *Salvia lanceolata*,' by G. W. Newton; a description of the structure of blossom and means of pollination.

'Notes on some Introduced Plants in Iowa,' by L. H. Pammel; covering introduction, distribution and economic importance of a number of species.

'A Study of the Leaf Anatomy of some Species of the Genus Bromus,' by Emma Sirrine; giving details of the epidermis, especially the bulliform cells, stereome and mestome.

'A Comparative Study of the Leaves of *Lolium*, *Festuca* and *Bromus*,' by Emma Pammel. In *Festuca tenella* the bulliform cells are wanting, while well developed in *Lolium perenne* and but slightly in *Bromus racemosus*.

'Anatomical Study of the Leaves of Certain Species of the Genus *Andropogon*,' by C. B. Weaver. In the species studied there appeared to be characters of specific value.

'Some Anatomical Studies of the Leaves of *Eragrostis*,' by C. R. Ball. In this genus the anatomical characters appear to be insufficient for specific characterizations.

'The Uses of Formaldehyde in Animal Morphology,' by Gilbert L. Houser, discussed the peculiar properties of this reagent, its disadvantages and the advantages in its use in certain fixing agents and its value in neurological work.

'The Nerve Cells of the Shark's Brain,' by Gilbert L. Houser. Morphological value, general features of structure and results attained by use of the Golgi method.

'Some Manitoba Cladocera,' with description of one new species, by L. S. Ross, included notes on the author's collecting and the description of a new species of *Ceriodaphnia*.

The same author presented papers on 'A New Species of *Daphnia* and Notes on Other Cladocera of Iowa,' and a description of 'The Illinois Biological Station.'

Mr. Charles Carter remarked upon 'The Odonata of Iowa,' and requested specimens and correspondence relating to the insects of this order, with a view to presenting a complete catalogue of the species of the State.

'Notes on the Orthopterous Fauna of Iowa,' by E. D. Ball, lists the known species of the State and includes remarks on distribution and life histories.

'The Ophidia of Iowa,' by A. H. Conrad, calls attention to the desirability of a study of the State fauna before many of the species become entirely extinct. The author desires material for study.

'Contributions to the Hemipterous Fauna of Iowa,' by Herbert Osborn, gives a list of about 100 species not hitherto recorded for the State, and notes on the life histories of certain species.

The following papers were read by title: 'Vertical Range of Fossils at Louisiana,' by C. R. Keyes and R. R. Rowley, and 'The Probable Life History of *Crepidodera cucumeris*, by F. A. Sirrine.

In business sessions the Academy adopted strong resolutions against the passage of anti-vivisection laws for the District of Columbia, voted a contribution to the Pasteur Monument Fund and elected the following officers for the ensuing year: President, W. S. Franklin; First Vice-President, T. H. MacBride; Second Vice-President, B. Fink; Secretary-Treasurer, Herbert Osborn; Elective Members of Executive Committee, L. S. Ross, J. L. Tilton and C. O. Bates.

HERBERT OSBORN,
Secretary.

THE SCIENTIFC ASSOCIATION OF THE JOHNS HOPKINS UNIVERSITY.

THE one hundred and thirtieth regular meeting was held January 21, 1897, Vice-President Howell in the chair.

The papers presented and read were:

The Stratification of Glaciers and the Origin of Some Moraines: By HARRY FIELDING REID. Observations were begun last summer to determine the actual direction of the motion of the ice of the Forno glacier in Switzerland. They will be completed next summer. The vertical as well as the horizontal components of the motion in different parts of the glacier will be determined. This is to test a theory published in the *Journal of Geology*, Vol. IV., p. 913, in which it is shown that the vertical component of the movement should be downward above the névé-line and upward below it. If this is true, then material dropped from the cliffs in the reservoir of the glacier should disappear and emerge again at the surface below the névé-line. Such moraines were found and were seen to be intimately connected with the stratification. All the observations on the Forno glacier indicate that what Forbes called the 'ribboned structure' is, as Agassiz contended, the outcrop of the strata. The very bad weather last summer interfered so much with the work that this conclusion could not be finally confirmed or disproved.

Some Recent Advances in Spectrum Analysis: By JOSEPH S. AMES. Attention was called to the fact that the supposed discovery of oxygen in the sun was disproved by observations of Mr. Jewell; that as yet there was no spectroscopic evidence of the presence of *two* elementary gases in clevite gas; that for the formula connecting lines in the series so often observed in spectra Balmer has recently suggested

$$\frac{1}{\lambda} = a - \frac{b}{n^2 + c}$$

where $n = 3, 4, 5$, etc.; that series of this kind have been discovered in the spectrum of oxygen; that a most important mathematical relation has been found to exist between the series observed in the spectrum of any one element. The importance of the study of these series with reference to molecular theories was touched upon.

CHAS. LANE POOR,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.—271ST MEETING, SATURDAY, JANUARY 30.

DR. C. HART MERRIAM spoke of 'The Pribilof Island Hair Seal,' stating that it differed from the Eastern Harbor seal, *Phoca vitulina*, in its greater size, in the simpler character of the true molars and in the greater extent of the articulation of the premaxillaries with the nasals. As specimens were lacking between Greenland and Bering Sea, it was uncertain whether the Pribilof seal was a species or subspecies, although it was probably the latter. Several names had been applied to hair seals from the North Pacific, but the one which would probably stand was *Phoca larga*.

Mr. C. H. Townsend presented a paper on 'The Origin of the Alaskan Live Mammoth Story,' saying that of late years many reports had appeared in newspapers to the effect that Indians declared that the mammoth was still living in Alaska. The speaker stated that in 1885 he visited Cape Prince of Wales in the Corwin, and, in reply to questions of the natives concerning the bones of the mammoth with which they were familiar, showed them figures of the skeleton and drew a restoration of the animal. These figures were copied by the natives, and, as the natives of widely separated regions have communication with each other by canoes and dog teams, he had no doubt that in this manner the figure and information had become widely spread. Being subsequently related and shown to visitors these had given rise to the reports of living mammoths.

Mr. Frank Benton spoke at some length on 'The Giant Bee of India,' saying that apiarians were much interested in introducing this species into the United States, owing to the increasing demand for wax in the arts. The species built a large comb on the under side of a limb or overhanging rock, and was much sought for by the natives of the regions where it is found. Mr. Benton described his efforts to obtain specimens and bring them to the United States and said that, although these first attempts had not succeeded, he thought that the bee could be successfully introduced into the southern United States.

Mr. L. O. Howard presented a communication entitled 'Parasites of Shade-tree Insects in Washington,' in which he showed the exact details of the reduction of *Orgyia leucostigma*, which appeared in extraordinary numbers in the District of Columbia in the summer of 1895, to perfect harmlessness in the summer of 1896. Thirty-seven species of parasitic insects were engaged in this work; 17 species were primary Hymenopterous parasites, 6 primary Dipterous parasites and 14 Hymenopterous hyperparasites. Among the hyperparasites 12 were secondary, 2 tertiary and one of the latter probably also quaternary. The speaker generalized at some length on the subject of insect parasitism as illustrated by this rather striking instance.

F. A. LUCAS,
Secretary.

NEW YORK ACADEMY OF SCIENCES, BIOLOGICAL SECTION, JANUARY 11, 1897.

DR. G. S. HUNTINGTON read a paper entitled 'A Contribution to the Myology of *Lemur bruneus*.'

The paper deals with some of the ventral trunk muscles and the appendicular muscles of the forelimb and pectoral girdle. A comparison of the structure of these muscles with the corresponding parts in other members of the sub-

order shows *L. bruneus* to possess marked primate characters in the arrangement of the pectoral girdle muscles and the muscles of the proximal segment of the anterior limb. This is especially evident in the lateral recession of the pectorales; the compound character of the ectopectoral insertion, the junctions of a pectoralis abdominalis with the typical entopectoral insertion, and the presence of an axillary muscular arch, derived from the tendons of the Latissimus dorsi and connected with the deep plane of insertion of the ectopectoral tendon.

The presence of a third or inferior portion of the coraco-brachialis is noted in addition to the upper and middle portion usually present in Lemuroidia.

The ventral trunk muscles present a distinct carnivore type in their arrangement, instanced by the high thoracic extension of the rectus abdominalis, the occurrence of a well-developed supra costalis, the union of levator scapulæ and serratus magnus, the thoracic extension of the scalenus group; interlocking both with the serratus magnus and obliquus externus.

The aponeurosis of the obliquus externuus presents a well-developed division of the internal pillar of the external abdominal ring, dove-tailing with the one from the opposite side and forming the triangular ligament of the same.

Mr. H. E. Crampton, Jr., reported some of his 'Observations upon Fertilization in Gasteropods.'

The observations were made upon the eggs of a species of *Doris*, collected last summer on the Pacific Coast by Mr. Calkins, and upon a species of *Bulla* which deposited eggs at Woods Holl during the months of August and September. The results may best be summarized by stating that a complete confirmation was obtained of the accounts of fertilization given by Wilson and Mathews, Boveri, Hill for sea-urchins, Meade on *Chetopterus Kostanecki* and Wiejyewski upon *Physa*, etc. The sperm nucleus is preceded by the divided centrosome, an aster, however, not being found till the union of the germ-nuclei. The first polar spindle lies at each pole a double centrosome, the second maturation spindle but one. These are of great size, however, and the one remaining in the egg finally disintegrates, the centrosomes of the first cleavage spindle being derived from the sperm. The germ-nuclei do not fuse, but lie very close to one another, in contact.

Mr. N. R. Harrrington gave an account of the life history of Entoconcha, a mollusc parasitic in a Holothurian. His paper was illustrated by photographs.

The following paper was read by title:

N. R. Harrington and B. B. Griffin: 'Notes on the Distribution, Habits and Habitat of some Puget Sound Invertebrates.'

C. L. Bristol,
Secretary.

NEW BOOKS.

Travels in West Africa. Mary H. Kingsley. London and New York, The Macmillan Company. 1897. Pp. xvi+736. $6.50.

Experimental Morphology. Charles Benedict Davenport. New York and London, The Macmillan Company. 1897. Part I. Pp. xiv+280. $2.60.

Microscopic Researches on the Formative Property of Glycogen. Charles Creighton. London, Adam and Charles Black. 1896. Part I. Pp. viii+152 and Five Plates.

Traité élémentaire de méchanique chemique. P. Duhem. Paris, A. Hermann. 1897. Pp. viii+299.

Vorlesungen über die electromagnetische Theorie des Lichts. H. von Helmholtz. Hamburg and Leipzig, Leopold Voss. V. Pp. xii+370. M. 14.

Elementary Human Physiology. John Gray McKendrick. London, W. & R. Chambers, Ltd. 1896. Pp. 240+xvi.

A Laboratory Note-Book of Elementary Practical Physics. L. R. Wilberforce and T. C. Fitzpatrick. Cambridge University Press. 1896. Part I., pp. 31. Part II., pp. 46. Part III., pp. 39. 3s.

Untersuchungen über die Sinnesfunctionens der Menschlichen Haut. May von Frey. Leipzig, S. Hirzel. 1896. No. III. Pp. 175-266. Einzelpreis. 5 M.

Spectralanalytische Untersuchung des Argons. J. M. Eder and E. Valenta. Gerold, Vienna. 1896. Pp. 39.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, FEBRUARY 26, 1897.

CONTENTS:

Earth-crust Movements and their Causes: JOSEPH LE CONTE.....321

Notes on Certain Beliefs concerning Will Power among the Siouan Tribes: ALICE C. FLETCHER..331

The Sand-plains of Truro, Wellfleet and Eastham: AMADEUS W. GRABAU.....334

A New Method of Driving an Induction Coil: CHAS. L. NORTON, RALPH R. LAWRENCE.....335

Current Notes on Physiography:—
The Colorado Plains; The Pre-glacial Kanawha; The Rivers of Saginaw Bay: W. M. DAVIS.....336

Current Notes on Meteorology:—
Chalk-plate Weather Maps; Prizes for School Work in Meteorology; Some Interesting Reprints: R. DEC. WARD.....337

Current Notes on Anthropology:—
The Age of Man; On Small Chipped Flints: D. G. BRINTON.....339

Scientific Notes and News.....339

University and Educational News.....343

Discussion and Correspondence:—
The Argentaurum Papers: C. A. YOUNG. *Former Extension of Greenland Glaciers*: RALPH S. TARR. *Compliment or Plagiarism*: GEORGE BRUCE HALSTED. *The National University—A Suggestion*: WILLIAM TRELEASE.....343

Scientific Literature:—
Groos on Die Spiele der Thiere: J. MARK BALDWIN. *Ball's History of Mathematics; Cajori's History of Elementary Mathematics*: E. M. BLAKE. *Klebs on Die Bedingungen der Fortpflanzung bei einigen Algen und Pilzen*: GEO. F. ATKINSON. *Codice Messicano Vaticano*: D. G. BRINTON.....347

Scientific Journals:—
American Chemical Journal: J. ELLIOTT GILPIN. *The Journal of Comparative Neurology; American Geologist*.....356

Societies and Academies:—
The New York Academy of Sciences—Section of Astronomy and Physics: WM. HALLOCK; *Section of Geology*: J. F. KEMP. *New York Section of the American Chemical Society*: DURAND WOODMAN. *Geological Society of Washington*: W. F. MORSELL. *Boston Society of Natural History*: SAMUEL HENSHAW. *The Academy of Science of St. Louis*: WM. TRELEASE. *The Texas Academy of Science*: FREDERIC W. SIMONDS. *The Geological Club of the University of Minnesota*: CHARLES P. BERKEY.....359

New Books.....364

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EARTH-CRUST MOVEMENTS AND THEIR CAUSES. *

INTRODUCTION.—SOURCES OF ENERGY.

NEARLY all the processes of nature visible to us—well-nigh the whole drama of nature enacted here on the surface of the earth—derive their forces from the sun. Currents of air and water in their eternally recurring cycles are a circulation driven by the sun. Plants derive their forces directly, and those of animals indirectly through plants, from it. All our machinery, whether wind-driven, or water-driven, or steam-driven, or electricity-driven, and even all the phenomena of intellectual, moral and social activity, have still this same source. There is one, and but one, exception to this almost universal law, namely, that class of phenomena which geologists group under the general head of *igneous agencies*, comprising volcanoes, earthquakes, and more gradual movements of the earth's crust.

* Annual address by the President, Joseph Le Conte, read before the Geological Society of America, December 29, 1896.

Thus, then, all geological agencies are primarily divided into two groups. In the one group came atmospheric, aqueous and organic agencies, together with all other terrestrial phenomena which constitute the material of science; in the other group, igneous agencies and their phenomena alone. The forces in the group are exterior; in the other, interior; in the one, sun-derived; in the other, earth-derived. The one forms, the other sculptures, the earth's features; the one rough-hews, the other shapes. The general effect of the one is to increase the inequalities of the earth's surface, the other to decrease and finally to destroy them. The configuration of the earth's surface, the distribution of land and water—in a word, all that constitutes physical geography at any geological time—is determined by the state of balance between these two eternally antagonistic forces.

PHENOMENA TO BE STUDIED.

Now the phenomena of the first group, lying, as they do, on the surface and subject to direct observation, are comparatively well understood as to their laws and their causes. While the causes of the phenomena of the second group, hidden forever from direct observation in the inaccessible depths of the earth's interior, are still very obscure; and yet partly on account of this very obscurity, but mainly on account of their fundamental importance, it is just these which are the most fascinating to the geologist. The former group, constituting, as it does, the terrestrial drama enacted by the sun, its interest is shared by geology equally with other departments of science, such as physics, chemistry and biology. The phenomena of the second group are more distinctively the field of geology.

If we compare the earth with an organism then these interior forces constitute its life-force, while the other group may be likened to the physical environments against which it eternally struggles, and the outcome of this struggle determines the course of the evolution of the whole. Now in biological science nearly the whole advance has heretofore been by study of the external and more easily understood phenomena, thus clearing the ground and gathering material for attack on the interior fortress, and the next great advance must be through better knowledge of the vital forces themselves. The same is true of geology. Nearly all the progress has heretofore been by the study of the exterior phenomena, such as erosion, transportation, sedimentation, stratification, distribution of organic forms in space and their succession in time, etc. Many of the laws of these phenomena have already been outlined, and progress to-day is mainly in filling in and completing this outline; but the next great step must be through a better knowledge of the interior forces. This is just what geological science is waiting for to-day. Now the first step in this direction is a clear statement of the problems to be solved. The object of this address is to contribute something, however small, to such clear statement.

EFFECTS OF INTERIOR FORCES.

As the interior of the earth is inaccessible to direct observation, we can reason concerning interior forces only by observation of their effects on the surface. Now these effects, as usually treated, are of three main kinds: (1) Volcanoes, including all eruptions of material from the interior; (2) Earthquakes, including all sensible movements, great and small; (3) Gradual small movements effecting large areas, imperceptible to the senses, but accumulating through indefinite time.

It is certain that of these three the last is by far the most fundamental and important, being, indeed, the cause of the other two.

Volcanoes and earthquakes, although so striking and conspicuous, are probably but occasional accidents in the slow march of these grander movements. It is only of these last, therefore, that we shall now speak.

KINDS AND GRADES OF EARTH-CRUST MOVEMENTS.

The movements of the earth's crust determined by interior forces are of four orders of greatness: (1) Those greatest, most extensive, and probably primitive movements by which oceanic basins and continental masses were first differentiated and afterward developed to their present condition; (2) those movements by lateral thrust by which mountain ranges were formed and continued to grow until balanced by exterior erosive forces; (3) certain movements, often over large areas, but not continuous in one direction, and therefore not indefinitely cumulative like the two preceding, but oscillatory, first in one direction, then in another, now upward and then downward; (4) movements by gravitative readjustment, determined by transfer of load from one place to another. Perhaps this last does not belong strictly to pure interior or earth-derived forces, since the transfer of load is probably always by exterior or sun-derived forces. Nevertheless they are so important as modifying the effects of other movements and have so important a bearing on the interior condition of the earth that they cannot be omitted in this connection.

Now of these four kinds and grades of movement the first two are primary and continuous in the same direction, and therefore cumulative, until balanced by leveling agencies. The other two, on the contrary, are not necessarily continuous in the same direction, but oscillatory. They are, moreover, secondary and are imposed on the other two or primary movements as modifying, obscuring, and often even completely masking their effects. This important point will be brought out as we proceed. We will take up these movements successively in the order indicated above.

1. *Ocean Basin-making Movements.*

I have already given my views on this most fundamental question very briefly in my 'Elements of Geology,' a little more fully in my first paper, 'Origin of Earth Features,'* and in my memoir of Dana.† I give it still more fully now.

We may assume that the earth was at one time an incandescent, fused spheroid of much greater dimensions than now, and that it gradually cooled, solidified, and contracted to its present form, condition and size. Now if at the time of its solidification it had been perfectly homogeneous in composition, in density and in conductivity in every part, then the cooling and contraction would have been equal on every radius, and it would have retained its perfect, evenly spheroidal form; but such absolute homogeneity in all parts of so large a body would be in the last degree improbable. If, then, over some large areas the matter of the earth were denser and more conductive than over other large areas, the former areas, by reason of their greater density alone, would sink below the mean level and form hollows; for even in a solid—much more in a semi-liquid, as the earth was at that time—there must have been static equilibrium (*isostasy*) between such large areas. This would be the beginning of oceanic basins; but the inequalities from this cause alone would probably be very small but for the concurrence of another and much greater cause, viz, the greater conductivity of the same areas. Conductivity is not, indeed, strictly proportional to destiny; but in a general way it is so. It is certain, therefore, that the denser areas would be also the more conduc-

*Am. Jour. Sci., 1872.

†Bull. Geol. Soc. Am., Vol. 7, 1895, pp. 461–474.

tive, and therefore the more rapidly cooling and contracting areas. This would again increase, and in this case progressively increase, the depression of these areas. The two causes — destiny and conductivity, isostasy and contraction—would concur, but the latter would be far the greater, because indefinitely cumulative. The originally evenly spheroidal lithosphere would thus be deformed or distorted, and the distortion, fixed by solidification, would be continually increased until now. When the earth cooled sufficiently to precipitate atmospheric vapor the watery envelope thus formed would accumulate in the basins of the lithosphere and form the oceans. It is possible, and even probable, that the depressions were at first so shallow that the primeval ocean may have been universal, but the process of greater downward contraction continuing, the ocean basins would become deeper and the less contracted portions of the lithosphere would appear as land. The process still continuing, the land would grow higher and more extensive and the ocean basins deeper and less extended throughout all geological time. On the whole, in spite of many oscillations, with increase and decrease of land, to be spoken of later, and in spite, too, of exterior agencies by erosion and sedimentation tending constantly to counteract these effects, such has been, I believe, the fact throughout all geological history.

It is evident, also, that on this view, since the same causes which originally formed the ocean basins have continued to operate in the same places, the positions of these greatest inequalities of the lithosphere have not substantially changed. This is the doctrine of the permanency of oceanic basins and continental masses, first announced by Dana. Some modification of this idea will come up under another head.

The objection which may be—which has been—raised against this view is that such heterogeneity as is here supposed, in a fused mass and therefore in a mass solidified from a state of fusion, is highly improbable, not to say impossible. This objection, I believe, will disappear when we remember the very small differences in conductivity, and therefore in contraction, that we are here dealing with; small, I mean, in comparison with the size of the earth. This is evident when we consider the inequalities of the earth's surface. The mean depth of the ocean is about two and one-half miles; the mean height of the land, about one-third of a mile. The mean inequality of the lithosphere, therefore, is less than three miles. This is $\frac{1}{1800}$ of the radius of the earth—less than $\frac{1}{100}$ of an inch (an almost imperceptible quantity) in a globe two feet in diameter. I believe that a perfectly spheriodal ball of plastic clay allowed to dry, or even a spheriodal ball of red-hot copper allowed to cool, would show more deformation by contraction than the lithosphere of the earth in its present condition. It is true the inequalities are more accentuated in some places, especially on the margins of the continental areas; but this is due to another cause, mountain-making, to be taken up later.

Another objection will doubtless occur to the thoughtful geologist. It would seem at first sight on this view that ocean areas cooling most rapidly ought to be the first to form a solid crust, and the crust (if there be any interior liquid still remaining) ought to be thickest, and therefore least subject to volcanic activity, there; but, on the contrary, we find that it is just in these areas that volcanoes are most abundant and active. It is for this reason that Dana believed that land areas were the first and ocean areas the last to crust over. This is probably true; but a little reflection will show that these two facts, namely, the earlier crusting of the land areas and the more rapid cooling and contraction of the

ocean areas, are not inconsistent with one another; for the more conductive and rapidly cooling areas would really be the last to crust, because surface solidification would be delayed by the easy transference of heat from below, while the less conductive land areas would certainly be the first to crust, because the non-conductivity of these areas would prevent the access of heat from below. Observation of lavas proves this. The most vesicular and non-conductive lavas are the soonest to crust, but for that very reason the slowest to cool to great depths.

No doubt many other objections may be raised, especially if we attempt to carry out the idea into detail; for the physical principles involved, and especially the conditions under which they acted, are far too complex and imperfectly understood to admit of such detail. It is safest, therefore, to confine ourselves to the most general statement.

It may be well to stop a moment to compare with the above view that of Dana, as interpreted and clearly presented by Gilbert in 1893.* (1) According to this view the earth is supposed to have first solidified at the center. This, on the whole, seems most probable. (2) The investing liquid, say from 50 to 100 miles thick, might well be supposed to arrange itself in layers of increasing density from the surface to the solid nucleus. Now suppose for any cause, less conductivity or other, certain areas crusted on the surface. These crusts would, of course, consist of the lighter superficial portions; but since rocks contract in the act of solidification,† these solidified crusts would sink to the nucleus and be replaced by similar lighter material flowing in from the surrounding surface, which in turn would solidify and sink. Thus would be built up from the nucleus below a solid mass consisting only of the superficial, lighter material to form the land, while the denser and less rapidly crusting material would form the ocean areas. As in my view, therefore, the oceanic areas are the denser and the land areas the lighter material.

It is evident that, according to either view, but especially according to mine, the material of the ocean basin areas down to the center of the earth must be as much denser than the material of the land areas down to the center as the subocean radii are shorter than the subcontinental radii, and therefore that the two areas must be in perfect static equilibrium with one another. Thus in the formation of continents the claims of isostasy are completely satisfied. I say completely because this is not a partial equilibrium resisted by rigidity but enforced by pressure; it is original and without stress.

2. *Mountain-making Movements.*

I have so recently discussed this subject* that I shall have little more to say now. Mountain ranges are of two types, namely, the anticlinal or typical and the monoclinal or exceptional. The one are mountains of folded structure, determined by lateral thrust, the other of simpler structure and determined by unequal settling of great crust blocks. It is only of the former that I shall speak now. The other or monoclinal type will come up under another head.

It will not be questioned that mountain ranges of the first type are formed by lateral thrust, however much we may differ as to the cause of such thrust; nor will it be questioned that they are permanent features determined by continuous movement, however much they may be modified by other kinds of movement or reduced or even destroyed by subsequent erosion. I have placed them, therefore, among the effects of

* Bull. Geol. Soc. Am., Vol. 4, 1893, p. 179.

† King and Barus. Am. Jour. Sci., Vol. 45, 1893, p. 1.

* President's address, Am. Asso. Adv. Sci., Madison meeting, 1893.

primary movements—that is, movements determined by causes affecting the whole earth. I have done so because until some more rational view shall be proposed I shall continue to hold that they are the effects of interior contraction concentrated upon certain lines of weakness of the crust and, therefore, of yielding to the lateral thrust thus generated. The reason for, as well as the objections to, this view I have already, on a previous occasion, fully discussed. I wish now only to supplement what I have before said by some further criticisms of the most recent and, some think, the most potent objection to this contractional theory, namely, that derived from the supposed position of the 'level of no strain.'

It is admitted that the whole force of this objection is based on the extreme superficiality of this level, and that this, in its turn, depends on the initial temperature of the incandescent earth and the time elapsed since it began to cool. Both these are admitted to be very uncertain. I have already discussed these in my previous paper and shall not repeat here; but, as recently shown by Davison,* there are still other elements, entirely left out of account in previous calculations, which must greatly affect the result, and these new elements all concur to place the level of no strain much deeper than previous calculations would make it.

These neglected elements are the following: (1) The earth increases in temperature as we go down. Now the coefficient of contraction increases with temperature. This would increase the depth of the level of no strain, and also, of course, the amount of interior contraction and, therefore, the lateral thrust. (2) The conductivity increases with the temperature. This also would increase the rate of cooling and, therefore, of interior contraction. (3) The interior of the earth is more conductive not only on account of its greater temperature, but also on account of its greater density; and this would be true whether the greater density be due to increased pressure or to difference of material, as, for example, to greater abundance of unoxidized metals. (4) The materials of the interior, aside from greater temperature and density, have a higher coefficient of contraction. (5) The usual calculations go on the assumption that the initial temperature was uniform for all depths. It probably increased with the depth then as now. This would again increase in an important degree both the depth of the level of no strain and the amount of lateral thrust.

The final result reached by Davison is, that while according to the usual calculations the level of no strain may be only a little over two miles (2.17) below the surface, yet, taking into account only the first element mentioned above, the depth of that level would be increased to nearly eight miles (7.79), and taking into account all the elements it would come out many times greater still. The general conclusion arrived at is that the objections to the contractional theory, based on the depth of the level of no strain, must be regarded as invalid.

3. *Oscillatory Movements.*

The movements thus far considered are continuously progressive in one direction as long as they last. The resulting features are therefore permanent, except in so far as they may be modified by other movements or by degrading influences; but nothing is more certain than that besides these more steady movements there have been others of a more oscillatory character—that is, upward and downward—in the same place, affecting now smaller, now larger areas, and often many times repeated. These are the most common of all crust movements, and are shown everywhere and in all periods of the earth's history by unconformities of the

*Am. Jour. Sci., Vol. 47, 1894, p. 480. Phil. Mag., Vol. 41, 1896, p. 133.

stratified series. Every line of unconformity marks an old eroded land surface, and every conformable series of strata a sea bottom receiving sediments. We give but two striking examples of such oscillations.

The Colorado plateau was a sea bottom, continuously or nearly so, from the beginning of the Carboniferous to the end of the Cretaceous, and during that time received about 12,000 or 15,000 feet in thickness of sediments. During the whole of this time the area of the earth's crust was slowly sinking and thus continually renewing the conditions of sedimentation. Why did it subside? At the end of the Cretaceous the same area began to rise. What change of conditions caused it now to rise? It has continued to rise until the present time, and is still rising. The whole amount of rise cannot be less than 20,000 feet; for if all the strata which have been removed by erosion were again restored, the highest portion of the arch which was sea bottom at the end of the Cretaceous would now be 20,000 feet high. This, however, is only the last oscillation of this area, for beneath the Carboniferous there are several unconformities showing several oscillations of the same kind in earlier periods. During the Devonian the area was land, for the Carboniferous rests unconformably on the Silurian. During the Silurian it was sea bottom, receiving sediments of that time. Beneath the Silurian there are two other unconformities showing similar oscillations. These earlier oscillations were probably as great as the one now going on, but we cannot measure them as we can the last.

Another striking example, still more recent and widespread, is the enormous oscillations of the Glacial period. It cannot be doubted that over very wide areas—several millions of square miles—there were at that time upward and downward movements of several thousand feet, and therefore producing enormous changes in physical geography and climate. What was the cause of these movements? They were doubtless modified, as will be shown later, by other movements superimposed on them; but the causes of the latter must not be confounded with that of the former.

We have given only two striking examples, but they are really the commonest of all crust movements. They are everywhere marked by unconformities of the strata; they are everywhere going on at the present time. In some places the sea is advancing on a subsiding land; in others a rising land is advancing on the sea. These movements are more conspicuous along coastlines, because the sea is a datum level by which to measure them, but they affect equally the interior of continents, as shown by the behavior of the rivers, which seek their base level by erosion in a rising and by sedimentation in a sinking country.

Many theories have been advanced to explain these movements, especially of certain very local shoreline movements. In volcanic regions they have been attributed to rise or recession of the volcanic heat and consequent columnar expansion or contraction of the crust. On non-volcanic sedimentary shorelines elevation has been attributed by some to the rise of the interior heat of the earth and conseqent expansion of the crust produced by the blanketing effect of sedimentary deposit; while others, with more reason, think that regions of heavy sedimentation sink under the increasing load of accumulating sediments; but it is evident that, while such theories may explain some local examples in volcanic regions and along some shorelines, they cannot explain subsidences in the interior of continents, much less the wider and more extensive movements spoken of above. We must look for some more general cause. What is it?

It must be confessed that the cause of

these oscillatory movements is the most inexplicable problem in geology. Not the slightest glimmer of light has yet been shed on it. I bring forward the problem here, not to solve it, for I confess my inability, but to differentiate it from other problems, and especially to draw attention to these movements as modifying the effects of movements of the first kind, and often so greatly modifying them as to obscure the principle of the permanency of oceanic basins and continental areas, and even to cause many to deny its truth. Nearly all the changes in physical geography in geological times, with their consequent changes in climate and in the character and distribution of organic forms—in fact, nearly all the details of the history of the earth—have been determined by these oscillatory movements; but amid all these oscillatory changes, sometimes of enormous amount and extent, it is believed that the places of the deep oceanic basins and of the continental masses, being determined by other and more primary causes, have remained substantially the same.

4. *Movements by Gravitative Readjustments—Isostasy.*

This very important principle which, though partially recognized by Herschell, was first clearly enunciated by Major Dutton under the name isostasy.* The principle may be briefly stated thus: In so large a mass as the earth, whether liquid within or solid throughout it matters not, excess or deficit of weight over large areas cannot exist permanently. The earth must gradually yield fluidally or plastically until static equilibrium is established or nearly so. Thus continuous transfer of material from one place to another by erosion and sedimentation must be attended with sinking of the crust in the loaded and rising of the crust in the unloaded area. In this way we may account for the sinking of the crust at the mouths of great rivers and the correlative rising of interior plateaus and nearly all great mountain regions observable at the present time. The same seems to have been true in all geological times, for it is obviously impossible that 40,000 feet of sediments could have accumulated in the Appalachian region in preparation for the Appalachian's birth unless there were continuous *pari passu* subsidence ever renewing the conditions of sedimentation.

Now there can be no doubt as to the value of this principle, but there is much doubt as to the extent of its application. The operation of exterior causes, such as transfer of load by erosion and sedimentation, are so comparatively simple and their effects so easily understood that we are tempted to push them beyond their legitimate domain, which in this case is to supplement and modify the more fundamental movements derived from interior causes. We are thus tempted to generalize too hastily and to conclude that all subsidence is due to weighting and all elevation to removal of weight. Probably this is a true cause, but not the main cause of such movements. Doubtless the proposition is true, but its converse is even much more so. It is certain that thick sediments may cause subsidence, but it is much more certain that subsidence, however determined, will cause continuous sedimentation by ever renewing the conditions of sedimentation. It is true that removal of weight by erosion will cause elevation, but it is more certain that elevation is the cause of removal of matter by erosion.

Take again the Plateau region as an example. We have seen that during the whole Carboniferous, Permian, Triassic, Jurassic and Cretaceous times this region was subsiding, until at the end of the Cretaceous the earth's crust here had bent downward 12,000 or 15,000 feet. Shall we say it went down under the increasing load of

* Phil. Society of Washington, 1892.

sediments? Why, then, did it, from a previous land condition, ever commence to subside? And why, when the load was greatest, namely, at the end of the Cretaceous, did it begin to rise? Again, from that time to this it has risen 20,000 feet? Of this about 12,000 feet have been removed by erosion, leaving still 8,000 feet of elevation remaining. Now if this elevation be the result of removal of weight by erosion, how is it that a removal of 12,000 feet has caused an elevation of 20,000 feet? This result is natural enough, however, if elevation was the cause and erosion the effect, for the effect ought to lag behind the cause. It is evident, then, that we must look elsewhere —that is, in the interior of the earth—for the fundamental cause, although, indeed, the effects of this interior cause may be increased and continued by the addition and removal of weight.

But perhaps the best illustration of the distinctness of the two kinds of causes of these movements is found in the oscillations of the Quaternary period. I say best because in this case the effects of the two may be disentangled and viewed separately, and this in its turn is possible because the loading in this case is not by mere transfer from one place to another, and therefore is not correlated with unloading. In fact, the elevation in this case is associated with, and in spite of, loading. The elevation, as we all know, commenced in late Tertiary and culminated in early Glacial. This elevation was, at least, one cause, probably the main cause, of the cold and the ice accumulation, but the elevation continued in spite of the accumulating load of ice. Finally, however, the accumulating load prevailed over the elevating force and the previously rising area began to sink, but only because the interior elevatory forces had commenced to die out. Then with the sinking commenced a moderation of the climate, melting of the ice, removal of load, and consequent rising of the crust to the present condition, but far below the previous elevated condition, because the elevating forces, whatever these were, had in the meantime exhausted themselves. If it had not been for the interference of the ice load, I suppose that instead of the double oscillation which actually occurred there would have been a simple curve of elevation coming down again to the present condition, but culminating a little later and rising a little higher than we actually find it did.

The question arises as to how great an area is necessary for the operation of the principle of isostasy? What extent and degree of inequality of surface may be upheld by earth rigidity alone?

The recent transcontinental gravitation determinations by Putnam and their interpretation by Gilbert* seem to show a degree of rigidity greater than previously supposed. They seem to show that while the whole continental arch is certainly sustained by isostasy—that is, by deficiency of density below the sea level in that part, the continental area being lighter in proportion as it is higher—yet great mountain ranges like the Appalachian, Colorado and Wasatch mountains show no such means of support, but are bodily upheld by earth rigidity; and even great plateaus, like the Colorado plateau, 275 miles across, are largely, though not entirely, sustained in the same way.

Monoclinal Mountain Ranges.

Until recently, mountain ranges were supposed to be all made in one way, namely, by lateral crushing and strata-folding and bulging along the line of yielding. To Gilbert is due the credit of having first drawn attention to another type, conspicuously represented only in the Plateau and Basin region, especially the latter—that is, those pro-

* Gilbert: Phil. Soc. Washington, Vol. 13, 1895, p. 31. Gilbert: Jour. Geology, Vol. 3, 1895, p. 331. O. Fisher: Nature, Vol. 52, 1895, p. 433.

duced by tilting and irregular settling of the crust blocks between great fissures. The two types of mountains are completely contrasted in all respects. As to form, the one is anticlinal, the other monoclinal. As to cause, the one is formed by lateral squeezing and strata-folding, the other by lateral stretching, fracturing, block-tilting and unequal settling. As to place of birth, the one is born of marginal sea bottoms, the other is formed in the land crust. Classified by form, we may regard the two types as belonging to the same grade of earth features, namely, mountain ranges; but classified by their generating forces, they belong to entirely different groups of earth movement. The one belongs to the second group mentioned above, the other to the third and fourth groups; for the plateau-lifting, crust-arching and consequent tension and fracturing belong to the third group or oscillatory movements, but the mountain-making proper—that is, the subsequent block-tilting and unequal settling—belongs to the fourth group or isostasy, for that is wholly the result of isostatic readjustment and is one of the best illustrations of this principle. It shows on what comparatively small scale under favorable conditions (probably unstable foundation) the principle of isostasy may act. It is evident, then, that it is impossible to exaggerate the distinction between these two types of mountains. They belong, as we have seen, to entirely different categories of interior forces, and, indeed, are not both mountains in the same sense at all. It was for this reason that, in my paper on mountain structure,* I put these latter in the category of mountain ridges instead of mountain ranges—of modification, not of formation. I now think it better to divide mountain ranges into two types, not forgetting, however, the very great distinction between them.

* Am. Jour. Sci., Vol. 16, 1878, p. 95.

Conclusions.

To sum up, then, in a few words: There are two primary and permanent kinds of crust movements, namely: (*a*) those which give rise to those greatest inequalities of the earth's surface—oceanic basins and continental surfaces; and (*b*) those which by interior contraction determine mountains of folded structure. These two are wholly determined by interior forces affecting the earth as a whole, the one by unequal radial contraction, the other by unequal concentric contraction—that is, contraction of the interior more than the exterior. There are also two secondary kinds of movement, which modify and often mask the effects of the other two and confuse our interpretation of them. These are: (*c*) those oscillatory movements, often affecting large areas, which have been the commonest and most conspicuous of all movements in every geological period, and are, indeed, the only ones distinctly observable and measurable at the present time, but for which no adequate cause has been assigned and no tenable theory proposed; and (*d*) isostatic movements or gravitative readjustments, by transfer of load from place to place, by erosion and sedimentation, or else loading and unloading by ice accumulation and removal, and also by readjustment of great crust blocks. If the previous one (*c*) or oscillatory movements have masked and so obscured the effects of (*a*) continent and ocean basin-making, this last (*d*), isostasy, has concealed the effects and obscured the interpretation of all the others, but especially of (*b* and *c*) mountain-making forces and the forces of oscillatory movements. In fact, in the minds of some recent writers it has well-nigh monopolized the whole field of crust movements. We shall not make secure progress until we keep these several kinds of movements and their causes distinct in our minds.

Joseph Le Conte.

NOTES ON CERTAIN BELIEFS CONCERNING WILL POWER AMONG THE SIOUAN TRIBES.

WILHELM VON HUMBOLDT, in his memoir upon 'The American Verb,' in summing up the results of his profound study, makes the following statement (I quote from the translation of Dr. Daniel G. Brinton): "The leading and governing part of speech in them [the American languages under consideration] is the Pronoun; every subject of discourse is connected with the idea of Personality."

The Siouan linguistic group was not included in the number of languages concerning which the learned author made this statement, but, as the group presents no evidence to controvert his general conclusion, it may be considered as forming no exception to this characteristic of the American tongues.

It is not the purpose of this brief paper to discuss linguistic questions, but to call your attention to certain words, customs and ceremonies in which we seem to trace the operation of that psychic peculiarity which has left so marked an impress upon the languages of the American people—the dominance of 'the idea of Personality.'

In considering the emblematic use of the tree in the Dakotan group, the Siouan Indian's anthropomorphic conception of nature was pointed out, and the fundamental reason of this conception was indicated as lying in his predicating of the permeating life of the universe, that peculiar quality or power of which he as a man was conscious within himself, to wit, the power by which he directed his own acts, or willed a course by which to bring about certain results. This quality or power he may be said to have deified under the term Wa-*kan*-da (using the Omaha and Ponka tongue), the hidden and mysterious power which brings to pass.

The name of that by which a man thinks, feels and wills, is called in the Omaha language Wa-zhi*n*'. A glance at some of the terms in which Wa-zhi*n*' is used will illustrate the mental conception of which the word is an expression.

Wi'-e-wa-zhi*n* means, to do a thing of one's own accord, of one's free will, unbiased or uninfluenced by another. (Wi, I; e, the sign of objective; wa-zhi*n*', directive energy or will power.)

When the Omaha first saw a railroad train, and watched it moving along without any visible aid from man or animal, they gave it the name which it bears in their language to-day, E'-wa-zhi*n*-no*n*-ge, literally translated, "it of its own accord runs." (E, it; wa-zhi*n*', will power; no*n*-ge, runs.) The childlike simplicity of this descriptive term throws light upon the meaning of wa-zhi*n*', and helps us to understand other words whereof it forms a part.

Anger is called Wa-zhi*n*'-pi-a-zhi. Pi-a-zhi signifies bad, evil. Wa-zhi*n*'-pi-a zhi indicates that in anger the will power of the man is charged with evil, and he becomes dangerous to himself and to others.

A very different condition of mind is represented by the Word Wa-zhi*n*'-tha-be, which denotes kindness, and also hospitality. Tha-be' is to be guarded, circumspect in one's words and acts; so we learn that the idea of kindness is to use one's will power to guard one's speech and conduct, so as not to injure any one. In the employment of this word to express the idea of hospitality we discern the broadening of the social feeling through the growth of the higher sentiments.

Wa-zhi*n*'-thne-de, the word for patience, presents another aspect of the idea of self-control. Thne-de means long. To be patient, therefore, demands that the energy of the Ego shall be held for a length of time to a given course.

Examples could be multiplied showing the use of wa-zhi*n*' in compounding words,

but I will mention only three more instances—three words which are used in connection with certain rites and customs, where, while they serve to explain the ceremonies, the ceremonies themselves throw light upon the psychic phenomena which the words are intended to portray. These three words are, Wa-zhi*n*'-dhe-dhe, Wa-zhi*n*'-a-gdhe and Wa-zhi*n*'-ska.

There is hardly an equivalent in English for the word Wa-zhi*n*-dhe-dhe, unless it is 'telepathy.' Dhe'-dhe is to send, and the word wa-zhi*n*'-dhe-dhe signifies to send forth one's thought and will power toward another in order to supplement his strength and thereby to affect his action. For instance, when a race is taking place, a man may bend his thought and his will upon one of the contestants, a friend or relative, in the belief that this act of his, this 'sending his mind,' will help his friend to win. Again, among the Omahas, when a man is on the war path, a group of women often of the poorer class, will gather at the tent of the absent warrior, and sing certain songs, called We-to*n*-wa-a*n*. These songs are the medium by which strength is conveyed to the man facing danger; the act is Wa-zhi*n*'-dhe-dhe. The words of these songs do not reveal the purpose for which they are sung; they sometimes refer to the difficult task that confronts the warrior, or they predict the bravery of the absent man when he shall meet the enemy, but the omission of any reference in them to the specific act of which the songs are a part is in keeping with the Indian's habit never to dilate upon that which is to him apparent. The family of the absent warrior, to whose tent the women have come to sing these We-to*n*-wa-a*n*, know what the songs are for, and so do all the people within reach of the sound of them. These songs, used solely for the purpose of Wa-zhi*n*'-dhe-dhe, are well known and form a class by themselves, and the belief in their power is unquestioned.

Other tribes in the Siouan group have similar methods to effect the same purpose, all bearing witness to the common belief among these Indians that will power can be projected to produce definite results.

Although a literal translation of Wa-zhi*n*'-a-gdhe (a'-ghde, to place upon) might seem at the first glance to indicate that the word had the same meaning as Wa-zhi*n*'-dhe-dhe (which, as we have just seen, is to send will power), the word really presents a very different phase of the belief we are considering. Wa-zhi*n*'-a-gdhe is the will power placed upon, that is the full consequence of a certain line of conduct are willed to fall upon the person who, of his own accord, has determined on that line of conduct. In ordinary speech the word is used when one abandons another to the natural outcome of unwise behavior, and ceases all efforts to arrest the consequent disastrous results.

This word is used to define a rite peculiar to the Ha*n*'-he-wa-chi. Ha*n*'-he-wa-chi means literally, 'in the night dance,' but the word refers to the dream or vision of the members. The Ha*n*'-he-wa-chi is a society composed of men who have achieved the right to put the Mark of Honor on a maiden. To do this, a man must be able to count one hundred or more deeds called Wa-dhi*n*'-e-dhe. When an Omaha reached that point he could look back over years of patient effort, of self-denial and dangers overcome; so long a time did it require for a man to arrive at this Honor that its acquisition was esteemed equal to the receiving of a vision. It was argued that the man must have had supernatural favor granted him or he could not have finally accomplished his purpose. This society was therefore regarded as composed of men possessing great power of mind and will, and they were accordingly looked up to in

the tribe. Each member had his own song or songs, and when they met together a part of the ceremony observed by them was the singing of these songs. If at such a time they fixed their minds upon a certain person whose conduct was displeasing to them they thus, by the act of Wa-zhi*n*'-a-gdhe, placed upon the offender the consequences of his acts, so that misfortune would befall him, and even death. It will be noted that this act of the society implied the exertion of a will power by its members which it was believed could isolate the object of their thought—their victim, we may say—and this isolation was effected in some way by thrusting him out of all helpful relations with men and animals, and in the end causing him to die.

Time forbids dwelling upon this curious and interesting belief, or noting the cumulative influence it exerted upon the individual, and upon the social conditions of the community that entertained it; all that can be pointed out at this time is the fact that such a belief was genuinely accepted by these Indians.

Wa-zhi*n*'-ska means intelligence, discernment, wisdom. Ska is white, or clear. The word has a broad significance, based upon the natural experience of seeing. When the atmosphere is clear a man can distinguish objects, note their pecularities, and their relation to each other; so, when the mind is clear, it is said the man's ability to know is not checked by dimness of apprehension, but because of the clear white light within his mind he is able to exercise the power of discrimination, and to discern that which will be conducive to the best interests of himself and others, and thus attain to wisdom.

Wa-zhi*n*'-ska is the word which designates the time when a youth, having passed the period of childhood, has reached the stage where he can enter upon a season of fasting and prayer in order to secure a vision. The mind of the child is said to be dark; he is like one in the night, unable to distinguish objects; as he grows older, light begins to dawn, and when he can distinctly remember and can place in order the sequence of events of which he has been cognizant, then his mind is said to be becoming 'white,' and he is approaching the suitable mental condition to enter upon the rite which may bring him into personal relations with Wa-ka*n*'-da, as manifested in concrete form through the medium of the vision. The use of the word Wa-zhi*n*'-ska to indicate this period in the life of a man is significant in view of the meaning of the word itself, and of the importance to the man of the rite he is about to practise.

The potentiality of the vision and its formative influence, as revealed in the development of the tribe, we have already discussed; the point to be emphasized just now is that in the rite by which the Indian seeks the potent vision the idea of his personality is kept intact.

It is of importance to observe in this connection that this rite, which is supposed to open to man the means by which his own powers may be supernaturally augmented, is not under the control of any priesthood or dependent upon any esoteric teaching; nor does it require that the individual merge himself in a society and have only a common right in the supernatural manifestation; nor does he through this rite come under the domination of any set of men. On the contrary, the rite is free and open to every individual who may elect to enter upon the seclusion and fasting and prayer incident to the seeking of a vision, and the securing of the sign that shall ever after be a credential with Wa-ka*n*-da. This sign is always the man's personal and sacred possession; it is something that no one can tamper with, nor can any one deprive him of its benefits.

This rite of the vision, which there is

reason to think is a very ancient one, bears testimony to the Indian's intense feeling of personality, a personality that to a degree was supposed to control the very vision itself; for the potency of the manifestation vouchsafed to a man in his vision was judged by the quality of the man's acts in after life. It was believed that a man of weak will and mind could not be the recipient of a vision that would give him great power, because such a man would not be capable of receiving such a manifestation from Wa-ka*n*-da. Thus the quality of a man's vision, which was to supplement his natural strength by supernatural power, depended upon the character of the man's Wa-zhi*n*', his mind, will-power and energy, or, in other words, his personality.

This estimate of a man's will-power could be traced in other words, customs and ceremonies of the Omahas, and in other tribes belonging to the Siouan group, for this belief was not only connected with sacred rites and social ceremonies, but it was also intermingled with homely customs and offices that were shared in by both old and young. In view of this wealth of testimony from the daily life of these Indians, it is not surprising that the languages of the people should betray the dominance of 'the idea of Personality.'

Alice C. Fletcher.

Peabody Museum,
Cambridge, Mass.

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*THE SAND-PLAINS OF TRURO, WELLFLEET, AND EASTHAM.**

Lower Cape Cod exclusive of Provincetown, or that portion of the Cape comprised within the townships of Truro, Wellfleet, and Eastham, is made up of a succession of sand-plains, of the type so prevalent in eastern Massachusetts. The plains are numerous, nevertheless they can all be referred to three distinct series, differing from each other in elevation and direction of extent. The northernmost of these are the *Truro Plains*, with an average elevation of eighty feet above sea level. These stretch from High Head southward to about half a mile below North Truro village and eastward to Highland Light. Transverse depressions, with a general northeast and southwest trend, separate the individual plains of this series on the west, while depressions with a north and south or a northwest and southeast trend limit them on the east. The slopes bounding these depressions have all the appearance of old constructional slopes, no indications of subsequent erosion having been observed. As an exception to this, however, the slopes bordering Salt Meadow and Moon Pond Meadow on both sides of High Head should be mentioned, these having all the appearance of ancient erosion scarps. The most typical of the northeast and southwest depressions is the one occupied by the road leading from North Truro station to Highland Light. Here the northern slope has all the characters of a southward descending *delta front* of an ordinary sand-plain, while the slope to the south of the road resembles a northward descending *ice-contact* slope. This difference in angle of slope is well shown by the fact that the village of North Truro is built wholly upon the gentler *delta* (?) slope north of the road. This relation of slopes holds for all the northeast and southwest depressions, while in the north and south and in the northwest and southeast depressions the steeper *ice-contact* (?) slope is invariably on the west, and the gentler *delta* (?) slope on the east. Kettle holes are common.

The *Wellfleet Plains* stretch southward from Highland Light to Wellfleet village, with an average elevation of 140 feet above sea level. Highland Light plain is a typical example. For the main part, a depression

* Abstract of a paper read before the Boston Society of Natural History, January 6, 1897.

exists between the Truro and Wellfleet plains, the latter presenting steep *ice-contact* (?) slopes towards the *northwest*.

South of North Truro village, however, the lower plain joins on directly to the higher. Kettle holes are common. Standing upon the high ground a mile north of Truro station and looking east, the whole series of plains seems to descend by a gentle *delta* (?) slope toward the west, leaving a deep and irregular depression occupied by the Provincetown turnpike. In the vicinity of Small's Hill a number of profound northeast and southwest depressions dissect the plain. These are occupied by the roads leading to the east shore. The slopes on both sides of these depressions are steep, and although they probably have been modified by wind the indications are that they are due to former lobes of ice dissecting the growing delta. Pamet River completely divides this series of plains, the southern portion being much more irregular and hummocky than the northern and also containing a number of kettle ponds.

The *Eastham Plains* are typically developed about North Eastham village. This series may be better regarded as one continuous plain uniform along the eastern shore from Wellfleet to the 'Three Lights,' where the elevation is about seventy-five feet above the sea, and the whole plain gently sloping westward. The northern half of this large plain is dissected by discontinuous east and west, and northwest and southeast depressions, with steep *ice-contact* (?) slopes on the south and lobate *delta* (?) slopes on the north. In the southern half of the plain the depressions have a north and south trend, with the steep *ice-contact* (?) slopes on the west and the *delta* (?) slopes on the east. South of Eastham Centre the plain joins on to the moraine. This plain was probably formed while the Truro Plains were accumulating and after the Wellfleet Plains had been formed. The latter seem to have been built by streams from the north and east. The Truro plains were built by streams from the northwest and northeast, while the Eastham Plain was being built by streams from the east. The terminology is applied to the slopes with some reservation, as almost the only criterion by which to judge of their character is the relative steepness and the general outline. Cuttings are very rare, and hence the relative coarseness of the material, and its disposition within the plains cannot be ascertained. The sections along the shore exhibit horizontal stratification where not covered by talus.

It seems difficult to believe that these plains have not accumulated in static water at the front of the much-dissected ice sheet. Submarine accumulation seems improbable, as erosion scarps would have been formed on the higher plains during the formation of the lower. On the other hand, if a body of fresh water was held up against the moraine, in an embayment in the ice front, it would be necessary to suppose that the ice held on to the moraine from Barnstable eastward, and that a residuary plug of ice filled the valley of Buzzard's Bay. This latter necessity is probably the most serious defect of the glacial lake theory.

AMADEUS W. GRABAU.

A NEW METHOD OF DRIVING AN INDUCTION COIL.

SINCE the induction coil has come into prominence through the discovery of the X-rays of Röntgen considerable attention has been turned toward devising some means which is applicable to long runs, on a voltage such as is furnished by electric light mains, 110 or 220 volts. The more recent forms of break work well with storage batteries, but these are troublesome, and a break which will work satisfactorily on the voltage of ordinary electric-light mains is

yet to be supplied. The following method has been devised to meet these difficulties:

A condenser of considerable capacity is first connected to the lighting mains and charged at 220 volts. It is then disconnected and discharged through the primary coil. The charging and discharging of the condensers is effected by means of a commutator. In this way the only current passing through the coil is from the condenser. The commutator is on the shaft of a small fan motor.

A six-inch Ritchie coil connected in this way with a condenser of 25 microfarads, its own condenser being disconnected, gives a thick fuzzy spark about two inches long. Removing the primary of the coil and replacing it by about seventy turns of rather heavy wire, number 8 or 6 B. & S., we get a multitude of fine zig-zag sparks about six inches long, the discharge being identical in appearance with that from an induction worked in the ordinary manner under the best conditions. The introduction of iron, unless finely laminated, cuts down the discharge to about one-tenth its value. Increasing the speed of the charge and discharge of the condenser up to about 2,000 per minute, which is the limit of the very crude commutator at present employed, improves the discharge of the coil in quantity and voltage. The sparking on the commutator is very slight, and the amount of power taken from the mains is small.

The discharge obtained in this way, so far as we can now judge, seems well suited for driving X-ray tubes. Tubes so driven give a brilliant fluorescent screen with strong sharp shadows. An exposure of twenty seconds gives a good photograph of the hand.

Chas. L. Norton,
Ralph R. Lawrence.

Rogers Laboratory of Physics,
Mass. Institute of Technology,
Boston, February 17, 1897.

CURRENT NOTES ON PHYSIOGRAPHY.

THE COLORADO PLAINS.

An essay by Gilbert on the 'Underground Water of the Arkansas Valley in Eastern Colorado' (17th Ann. Rep. U. S. Geol. Surv.) affords more specific information as to the topographic features of the plains and their origin than is usually obtainable from older reports. The general surface of the plains does not accord with the surface of their uppermost stratum, but bevels across the strata at a faint angle. The plains are therefore not in topographic youth, but in topographic old age, the result of a cycle of denudation during a lower stand of the land. On the peneplain thus formed there are now strewn the 'upland sands,' pebbly, cross-bedded, 50 to 200 feet thick; the pebbles being derived from the mountains on the west. This implies a period of aggradation, after the long preceding degradation. In explanation of the change it is suggested that the region may have been raised in the east or depressed in the west so as to lessen the slope of the rivers; to this there may be added a possible uplift of the mountains alone by which the load of the rivers would have been increased. To-day the sand-strewn peneplain is trenched by broad valleys, that of the Arkansas being fifteen or more miles wide and 400 to 800 feet deep. Successive pauses in the work of valley-cutting produced broad straths at lower and lower levels, whose remnants are now seen in gravel-covered terraces, the seat of much irrigated land. The eastward slope of the terraces is greater than that of the present grade of the river; hence a progressive uplift is argued during the excavation of the valley. The upland sands and the stream beds at low water supply sand to the northwest winds and extensive patches of dunes are thus formed, a system of hills and hollows without drainage by streams. The relation of Cretaceous strata, upland sands

and dunes to ground and underground water is fully discussed.

THE PREGLACIAL KANAWHA.

THE effect of drift obstructions in altering the courses of rivers in western Pennsylvania and eastern Ohio has been recognized for a number of years, the northward discharge to Lake Erie having been thereby greatly decreased. The diversion of the Missouri from a northward discharge to its present membership in the Mississippi system is also credited to glacial obstruction, and the important service of the great western river as a guide to western exploration, early and late, on our side of the Canadian boundary may, therefore, be credited, along with the water powers of New England, to the glacial period. Still another example of this kind is noted in the 17th Annual Report of the Geological Survey, in which the Director mentions a discovery by F. Leverett, with reference to the ancient drainage of the Virginias. The Kanawha, uniting with other streams in the western part of West Virginia and eastern Kentucky, ran in preglacial time northward towards Lake Erie, along a line partly coincident with the course of the south-flowing Scioto of to-day. This makes the preglacial drainage of the St. Lawrence include headwaters in North Carolina. The existing Ohio can, therefore, no longer be interpretated as of ancient origin, as if still flowing along a consequent course between paleozoic uplifts on the north and southeast. It is a composite stream of postglacial date. As a glacial product, it has been of even greater service than the Missouri, for our early settlers in its fertile lower valley took great advantage of its well-graded course, along which their advance was much easier than if they had had to go up and down hill, across the grain of various north-flowing rivers.*

*Some of my correspondents have pointed out that a suggestion regarding the origin of Teay valley (SCIENCE, II., 1895, 40) independent of the Kanawha, is inadmissible; for the valley contains gravels that could only have come from the upper Kanawha. Its origin by Big Coal river, therefore, seems out of the question.

THE RIVERS OF SAGINAW BAY.

A NUMBER of years ago Gilbert described the course of the Maumee river in northern Ohio, showing that its peculiar back-handed branches were consequent upon the faint relief determined by moraines and glacial lake beaches. A recent essay by Taylor (Correlation of Erie-Huron beaches with outlets and moraines in southeastern Michigan, Bull. Geol. Soc. Amer., VIII., 1897, 31–58) now gives another example of a very similar kind and warrants the recognition of these back-handed branches under some appropriate name, ready for convenient use when still other members of the class shall be discovered. Saginaw river, with its Cass and Tittibawasee arms, and swampy head opposite the upper course of Grand river, repeats the essential features of the Maumee to a nicety.

Back-handed branches resulting from the migration of divides quite independently of glacial constraint are easily distinguished from the class here considered. The barbed arrangement of the upper branches of the Maira recently diverted from the Inn on the watershed of the Alps are of this second class.

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CURRENT NOTES ON METEOROLOGY.

CHALK-PLATE WEATHER MAPS.

ONE of the recent improvements in the methods used by our Weather Bureau deserves mention in these Notes. As is generally known, the daily weather maps issued from the various Weather Bureau stations over the country have for some years been reproduced by a stencil process which, although a good method, when carefully ex-

ecuted, for a limited number of maps, becomes inadequate when several hundred copies have to be struck off. As a result of experiments, Mr. J. W. Smith, local forecast official of the Weather Bureau at Boston, Mass., suggested what is known as the chalk-plate printing process. It is as follows: A thin covering of specially prepared chalk ($\frac{1}{8}$ in. in thickness) is spread upon a steel plate of the size of the prospective weather map. On this chalk are engraved, by means of suitable instruments, the various weather symbols, the isobaric and isothermal lines, etc. The plate is then stereotyped in the ordinary way. In addition to the weather map proper, there is, of course, a considerable amount of printed matter, such as the forecast, summary, the table of instrumental readings, etc. This textual portion is made up by the use of logotypes, consisting of words, figures and phrases in which the different letters and figures are joined together in one solid piece of type to facilitate the work of setting up. Thus, when the word 'fair' or 'cloudy' has to be used, it is not necessary to set up the individual letters forming the word, but only to select the logotype which prints the word. After the text of the map is set up in logotypes, it is locked up with the stereotype map plate, and the whole is printed at one impression on a sheet prepared for the purpose, which has a blank outline map of the United States at the top, on which the weather map is printed, and space in the lower half of the sheet for the text and tables. The chalk-plate process map is in every way a great improvement on the stencil map which it has superseded. It is smaller, more convenient to handle, more legible and more attractive. A minute study of our daily weather maps is now a distinct pleasure, whereas formerly it was often a difficult task to attempt to puzzle out the faint lines, words and figures, which were too frequently barely legible. The size of the chalk-plate map itself is $10 \times 6\frac{1}{2}$ inches, and of the whole sheet, which includes also the text and tables, 16×11 inches. The first map made by this process issued from any Weather Bureau station was sent out from Boston on February 29, 1896. Since then the system has been extended as rapidly as possible to the other stations, and at the present time 21 stations issue chalk-plate maps. These are as follows: Boston, Mass.; Cleveland and Columbus, O.; Indianapolis, Ind.; Raleigh, N. C.; Nashville, Tenn.; Chicago, Ill.; Baltimore, Md.; Philadelphia, Pa.; New York and Buffalo, N. Y.; Milwaukee, Wis.; Galveston, Tex.; Louisville, Ky.; Little Rock, Ark.; Montgomery, Ala.; New Orleans, La.; Denver, Colo.; Lincoln, Neb.; Minneapolis, Minn.

PRIZES FOR SCHOOL WORK IN METEOROLOGY.

It is worthy of note in these columns that a definite step has been taken towards encouraging and systematizing school work in meteorology in the New England States. On the dissolution of the New England Meteorological Society, in 1896, a sum of money was left in the hands of a committee, to be used 'for some meteorological purposes.' The committee now offers three annual prizes, of twelve, ten and eight dollars, for the best work on weather and climate in any New England school below the high school, under certain conditions. The papers and record books sent in, in competition for the prizes, are to be wholly the work of the pupils whose names they bear, and all records are to be the result of the pupils' own observations. The committee suggests the following topics as appropriate subjects for such work: (1) Observation and record of simple weather elements. (2) Preparation of weather maps based on data supplied by the teacher. (3) The use of weather maps and of local observations in simple weather predictions. (4) Special observation and study of the elements that control the cli-

mate of New England. A circular giving full details has been issued, and may be procured from the undersigned.

SOME INTERESTING REPRINTS.

PROFESSOR HELLMANN, of Berlin, has recently issued three more of his *Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus*. These are: No. 7. EVANGELISTA TORRICELLI: *Esperienza dell 'Argento Vivo*. ACCADEMIA DEL CIMENTO: *Istrumenti per conoscer l'Alterazioni dell 'Aria*, containing the most important papers relating to the discovery of the barometer, thermometer and hygrometer, some of them in facsimile. No. 8. HALLEY, VON HUMBOLDT, LOOMIS, LEVERRIER and RENOU, *Meteorologische Karten*, being the earliest synoptic weather charts with wind, isotherms and isobars drawn between 1688 and 1864. No. 9. HENRY GELLIBRAND: *A Discourse Mathematical on the Variation of the Magnetical Needle*, containing the discovery of the secular variation of magnetic declination. This is a facsimile of the very rare work published in London in 1635. A few copies of these pamphlets may be had of A. L. Rotch, Blue Hill Observatory, Readville, Mass., at the publisher's price of 3 marks, or 75 cents each, postpaid.

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CURRENT NOTES ON ANTHROPOLOGY.

THE AGE OF MAN.

IN his recently published 'Handbuch der Palæontologie,' Professor Zittel, of Munich, reviews the alleged instances of the discovery of human remains in strata older than the alluvial period. His general conclusion is that "prehistoric researches do not yield positive information or definite results as to the antiquity of the human species." He follows Virchow in rejecting the high antiquity of the Neanderthal skull and denies that any discovery of glacial man in America has yet been made. He accepts, however, as probably 'fossil or quaternary,' the skull of Eguisheim, the jaw of Naulette and that of the Schipka cave, and the skull of Olmo in Tuscany.

Professor Morselli, who reviews Zittel's conclusions in the 'Archivio per l'Antropologia,' doubts the skull of Olmo, but argues that Zittel is generally too sceptical. He also adds the statement that the fossil human skeleton from the Pampean formation of the Argentine Republic, said by Zittel to be in the Museum of Milan, is not there.

ON SMALL CHIPPED FLINTS.

THERE is a class of small chipped flint objects, with a general similarity of shape and finish, found in England, France, Egypt, India, North Africa and elsewhere. In the *Revue de l'Ecole d'Anthropologie* for November, A. de Mortillet offers a careful study of their forms, geographical distribution, use and antiquity.

They are generally rudely triangular, rhomboidal, or like the segment of a circle. One edge is neatly dressed with secondary chipping, while another is left with the natural cleavage. The length varies from 15 to 35 millimeters. They may have been used as arrow points, as scarificators, as tools, or, in some instances, as fish hooks. In age, they appear to belong to the earliest neolithic period. Their singular similarity does not entail the proof of transmission, but rather of independent development.

While in America there are many specimens generally akin to these described by Mortillet, they cannot be said to represent any distinct culture area or period.

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SCIENTIFIC NOTES AND NEWS.

DR. THOMAS M. DROWN, President of Lehigh University, has been elected President of the American Institute of Mining Engineers.

THE students of the Massachusetts Institute

of Techology will place, as a memorial, a bust of the late President Walker in the corridor of the Rogers Building. The memorial will be designed by Mr. D. C. French.

At the regular January meeting of the Regents of the Smithsonian Institution, Mr. Charles D. Walcott was, as already noted, appointed Assistant Secretary of the Institution, and placed in charge of the U. S. National Museum, his official designation being 'Acting Assistant Secretary in Charge of the National Museum.' At an adjourned meeting of the Regents, Mr. Richard Rathbun was appointed Assistant Secretary 'with duties connected with the bureaus of the institution other than the National Museum,' and was placed in charge of the office and exchanges. By these appointments the position and duties of the late Dr. Goode are divided between two officials, of whom the last appointed performs certain additional duties.

It is stated in *Nature* that Lady Prestwich is collecting material for a biography of the late Sir Joseph Prestwich, and will be grateful to friends if they will forward to her any letters they possess, addressing to Shoreham, near Sevenoaks. They will be at once copied and carefully returned.

One of the silver medals of the Veitch memorial fund of London has been awarded to Professor L. H. Bailey for distinguished services to horticulture.

The Chanute prize of $100 for the best monograph on kites has been awarded by the Aeronautical Society to Professor C. F. Marvin, of the United States Weather Bureau.

The Royal Society of New South Wales has awarded its bronze medal and a money prize of £25 to J. Milne Curran for a paper on the occurrence of precious stones in New South Wales, with a description of the deposits in which they are found.

The University of Cambridge will confer the degree of LL. D. on Dr. Fridjof Nansen.

Dr. Julian Aparicio has been appointed Director of the Meteorological and Astronomical Observatory of San Salvador in the room of the late Dr. Don Alberto Sanchez.

Professor J. Franz, astronomer at the Königsberg Observatory, has been appointed Director of the Observatory at Breslau and professor at the University in the place of Professor T. Galle, who has retired.

Dr. F. Foli has retired from the Directorship of the Royal Observatory, Brussels.

M. Jean Perrin has been nominated by the Paris Academy of Sciences to the Joule Scholarship of the Royal Society, which is awarded alternately in England and in other countries.

We regret to record the deaths of Professor W. Wallace, professor of moral philosophy in the University of Oxford, who was killed on February 19th by a fall from a bicycle, and of Professor Charles Tomlinson, F. R. S., a writer and lecturer on scientific subjects, who died at Highgate, England, on February 15th.

Professor A von Kölliker, professor of anatomy in the University of Würzburg, will celebrate his eightieth birthday and the fifteenth anniversary of the commencement of his career of a teacher on July 6th.

Among the lectures given at the Royal Institution, London, during the present month were the following: February 11th, Dr. J. W. Gregory, of the British Museum (Natural History), the first of a course of three lectures on 'The Problems of Arctic Geology.' Friday evening discourse, February 12th, by Professor John Milne, F. R. S., on 'Recent Advances in Seismology.' February 19th, Mr. G. Johnstone Stoney, on 'The approaching return of the great swarm of November Meteors.'

Professor J. J. Stevenson, President of the New York Academy of Sciences, will give a public lecture before the Academy at Columbia University this evening. The subject is 'A Talk on Coal,' and the lecture will be illustrated.

The department of paleontology of the University of Kansas will send to the coming international exposition at Brussels copies of large restorations of seven extinct animals, based upon the material in the museum and prepared by or under the direction of Dr. Williston.

We learn from *Nature* that a German antarctic meteorological station will be established

shortly in Victoria Land, under the direction of Dr. Rudolph Mewes. The station will be in connection with the German South Polar expedition, and will have for its object the determination of meteorological conditions during the anarctic winter.

THE library of the late Professor du Bois-Reymond is offered for sale by Gustav Fock, Leipzig. It contains 14,000 books and pamphlets, including many valuable sets of periodicals. The heirs wish it to be sold as a unit and offer it for 22,000 Marks. It would be an unusually desirable acquisition for an American university library.

IT is reported that Mme. Larapidie has given money for a meteorological and astronomical observatory and a museum at Jerusalem.

THE Academy of Sciences of Vienna has sent to Bombay a commission, composed of Dr. Hermann Müller, Dr. Ghon, Dr. Albrecht and Dr. Pöch, to investigate the nature of the plague. The expenses are defrayed by the Treitl fund, left to the Academy by the late Herr Treitl, and amounting to $500,000.

A BILL has been introduced into the New York Legislature, authorizing New York City to spend $2,500,000 in the erection of a library building on the site of the reservoir adjoining Bryant Square. The income of the Astor, Lennox and Tilden foundations is about $160,000 annually, and if the building were provided this would be sufficient to maintain an adequate reference and circulating library in New York City.

THE fourth Annual Exhibit and Reception of the New York Academy of Sciences will be held at the American Museum of Natural History on Monday and Tuesday, April 5th and 6th, and will be open from eight to ten in the evening, and on April 6th from three to five in the afternoon. Arrangements are in progress for having a demonstration and lecture of about half an hour in length in the lecture hall each evening. Exhibits of newly invented apparatus will be welcomed from men of science, not resident in New York, who should address the Chairman of the Committee of Arrangements, Professor R. E. Dodge, Teachers' College, New York.

THE second annual convention of the American Association of Manufacturers met at Philadelphia on January 26th, 27th and 28th. The membership of this Association has during the past year increased from 300 to 900 and the revenue for the year amounted to $40,000. The Association has sent commissions to South America, Mexico and Japan to study manufactures and commerce, and the reports of these commissions and the results of the discussions on these and other subjects have a certain amount of scientific interest. It was recommended that a Department of Commerce and Manufacture be established under the government and that the consular service be placed under this proposed department.

As we reported sometime since, the sum of $60,000 left by the late Sir William Macleay, for the establishment of a lectureship in bacteriology in Sydney, was not accepted by the University, and reverted to the Linnean Society of New South Wales. The Society is now prepared to equip a laboratory and wishes to receive applications for the lectureship, the duties of which are chiefly research. The salary is £350.

D. APPLETON & Co. announce for early publication 'Pioneers of Evolution,' from Thales to Huxley, by Edward Clodd; 'The Aurora Borealis,' by Alfred Angot; and new editions of 'Dynamic Sociology,' by Professor Lester F. Ward, and 'Sight,' by Professor Joseph LeConte.

DR. JOHN W. HARSHBERGER, of the University of Pennsylvania, has now in manuscript a book entitled 'The Botanists of Philadelphia and their Work.' It will contain about 500 pages of printed matter and 50 full-page plates.

THE British Balneological and Climatological Society has published the first number of a new quarterly journal edited by Dr. Samuel Clyde, Chairman of the Council of the Society.

THE Foreign Affairs Committee of the House of Representatives will report favorably a bill for the reorganization of the Consular service. According to this bill a commission would be appointed by the President which would reorganize the service by a system of civil service examinations for admission, the abolition of the fee system and the rating of Consular offices in grades at stated salaries and tenure of office

during good behavior, with removals only by the action of a board after a trial on charges. A reform in the American Consular service might contribute to scientific progress, as it certainly would to economic and commercial interests. It is doubtful whether United States Consuls would be competent to write reports such as those of the British Consuls on the advantages of the metric system published in the last number of this JOURNAL.

KÖLLIKER'S well-known and esteemed shorter treatise on embryology entitled 'Grundriss der Entwickelungsgeschichte' is now being reissued. The preparation of the new edition (the third) has been entrusted to Professor Oscar Schultze. The first part has been issued by Engelmann, at Leipzig, and follows closely in typography and so forth the previous editions, which means that the illustrations are superior to what is usual in American and English scientific books. The present part deals with the early stages, the development of the external form and the fœtal envelopes and placenta. The scope of the text has been extended so as to make the book really a manual of mammalian embryology, and this has involved rewriting so extensive that we have practically a new work. It is one of very great merit; the difficult descriptions are both clear and concise, and the author displays a broad and accurate knowledge of his subject. We hope to give a fuller notice of the work upon its completion.

UP to February 18th the returns of the health authorities of the plague report that since its outbreak there have been 6,853 cases and 5,447 deaths from the disease in Bombay, and in the entire Presidency 9,911 cases and 8,006 deaths. The mortality attributed to other sources has also been excessive. 75 per cent. of the inhabitants have left Bombay. The conference on the plague now meeting in Venice has been divided into two bodies, but details regarding its work are lacking. It may, however, be well to quote from the *Times* some facts regarding this and preceding conferences: It will be practically the fourth of a series of international sanitary conferences, and will, it is expected, complete a system of efficacious measures for the prevention of the spread of epidemics. Now, as in the three preceding instances, the initiative is due to Austria-Hungary and has been taken exclusively for the general welfare. The upshot of the first sanitary conference, held at Venice in 1891, was to close the door in Egypt to the spread of epidemics to Europe. The result of the second conference, which was held at Dresden in 1893, was to adopt a maximum of protection accomplished by a minumum of hindrances to international traffic. On the basis of the Dresden Conference almost all the Powers concluded territorial conventions with their neighbors on very broad lines. The third conference, which met in Paris in 1894, supplemented the work of the two previous conferences with regard to the pilgrimages from India to the sanctuaries of the Sunnite Mahomedans at Mecca and Medina.

AN editorial article in the current number of the *Journal of Geology* recommends that the winter meetings of the Geological Society of America be held regularly in Washington. It is argued that the success of the recent meeting of the Geological Society was undoubtedly due to the fact that it was held in Washington. No other city in the country offers so many attractions to geologists in the winter time as the National capital. Containing, as it does, the largest body of geological investigators to be found in any one place in the world, it has become a center of geological activity and the repository of many valuable collections. Located within easy reach of the universities of the East and South and of the Middle West, it has become a favorite rendezvous for geologists scattered throughout these parts of the country. For these reasons the writer of the article holds that the suggestians made by Mr. Walcott, Director of the U. S. Geological Survey, that the Society hold all its winter meetings in Washington and its summer meetings elsewhere is an excellent one. It was heartily endorsed by the retiring President, Professor Le Conte.

DR. R. ELLSWORTH CALL has directed our attention to a report in the Indianapolis *Journal* of perhaps the most extraordinary piece of legislation ever undertaken. A bill has been passed by the Indiana Legislature, part of which reads as follows:

"It is impossible to compute the area of a circle on the diameter as the linear unit without trespassing upon the area outside of the circle to the extent of including one-fifth more area than is contained within the circle's circumference, because the square on the diameter produces the side of a square which equals nine when the arc of ninety degrees equals eight. By taking the quadrant of the circle's circumference for the linear unit we fulfill the requirements of both quadrature and rectification of the circle's circumference. Furthermore, it has revealed the ratio of the chord and arc of ninety degrees, which is as seven to eight, and also the ratio of the diagonal and one side of a square, which is as ten to seven, disclosing the fourth important fact, that the ratio of the diameter and circumference is as five-fourths to four, and because of these facts and the further fact that the rule in present use fails to work both ways mathematically it should be discarded as wholly wanting and misleading in its practical applications. * * * And be it remembered that these noted problems had been long since given up by scientific bodies as unsolvable mysteries and above man's ability to comprehend."

WE have received from the Australian Museum at Sydney, N. S. W., a memoir which is the first of a series giving an account of the Atoll of Funafuti by Mr. Charles Hedley, conchologist. We learn from an introductory note by the curator, Mr. R. Etheridge, Jr., that the local committee of the Funafuti Coral Reef Boring Expedition, of the Royal Society, in charge of Professor Sollas, having suggested to the Trustees of the Australian Museum that one of their officers should be deputed to accompany the expedition, Mr. Charles Hedley was selected for the purpose. Mr. Hedley left Sydney in H. M. S. 'Penguin,' under the command of Captain Mervyn Field, R. N., on May 1st, arriving at Funafuti on May 21st. He remained on the island for two and a half months, leaving in the same vessel. On the return voyage to Fiji, the Island of Nukulailai was touched at, where scientific investigations were renewed for two days. Mr. Hedley finally reached Sydney on August 22d. During his stay on Funafuti, Mr. Hedley succeeded in amassing an interesting collection, particularly of invertebrate and ethnological objects, together with much valuable scientific information. The collections are now in process of description by the Scientific Staff of the Museum, and the results are being published in the order in which the study of the various groups is completed.

UNIVERSITY AND EDUCATIONAL NEWS.

THE late Mr. William Lampson, of LeRoy, New York, has bequeathed his fortune, with the exception of a few small bequests, to Yale University. The bequest is said to amount to about $500,000. $150,000 is to be used for an auditorium and the rest for the endowment of professorships.

THE Stevens Institute of Technology, celebrated the 25th anniversary of its foundation on February 18th and 19th. There was a dinner at the Hotel Waldorf, a reception by Mrs. E. A. Stevens and a meeting at which addresses were made by Bishop Potter and President Morton, who described the achievements of the institution, its present condition and its future aims. Mr. Dod read a letter from President Morton, in which the President gave 1,000 shares of stock of the Texas Pacific Railroad to the board of trustees, 'to be held until their appreciated value with such other funds as may be devoted to the purpose, may be adequate for the erection and maintenance of the proposed new building generally referred to as the alumni building.'

THE Marquis of Bute, the present Lord Rector of the University of St. Andrews, will erect for the University four laboratories, including lecture rooms and museums, for the departments of anatomy, physiology, materia medica and botany.

MISS UMPHERSTON has been appointed lecturer in physiology at St. Andrews University.

DISCUSSION AND CORRESPONDENCE.

'THE ARGENTAURUM PAPERS.'

TO THE EDITOR OF SCIENCE: I think I ought not to pass unnoticed a statement and an unauthorized use of my name, made by Mr. S. H. Emmens in an advertisement just published in SCIENCE. He says: "The author has received many communications from eminent authorities explicitly approving of his work; while others have written in such a manner as to show that

they regard his arguments and mathematical demonstrations as incapable of refutation. Among these authorities may be named the following:" In the list of names there given my own appears.

The fact is that I regard the points he attacks as being beyond debate, and simply decline to discuss the matter with him, telling him as plainly as the forms of courtesy permit, that I consider his work of no value. I know personally that substantially the same is true of at least two others whose names are on the list, and have no doubt it is true of all. Comment is unnecessary.

C. A. YOUNG.

FEBRUARY 20, 1897.

[The responsible editor of this JOURNAL did not know of the insertion of the advertisement claiming the endorsement by Professor Young and others of Mr. Emmens' absurd book. He has written to the Macmillan Co. requesting that no further advertisement of the book be inserted. ED.]

FORMER EXTENSION OF GREENLAND GLACIERS.

I SHOULD be exceedingly sorry to misstate the views of a fellow worker, as Professor Chamberlin* infers that I have done, from a a short abstract† of a recent paper read before the Geological Society of America, but not yet published. His editorial places quite a different interpretation upon his views from that which I had gained from a reading of his articles. After a journey of a thousand miles along the Greenland coast, he says:‡ "The inference was drawn that the ice formerly so extended itself as to reach the present coast over about half of its extent, while in the remaining portion the ice fell short." Professor Salisbury§ states that the phenomena indicate that the ice has not recently overridden the 'islands of the coast of Greenland,' and moreover that it is a question if this is a possibility.

In his editorial Professor Chamberlin states: "In its bearings upon these general problems, an advance of a few miles, more or less, an ineffectual overtopping of a few heights, more or less, are relatively inconsequential. Our language is to be interpreted in the light of the major question whose solution we sought." These 'major questions' are: (1) whether the Greenland ice was the source of the American ice sheet, which I did not suppose that anyone seriously believed at present; and (2) whether the Greenland ice ever reached 'out into the heart of Baffin's Bay.'

It would not be profitable to restate any of the arguments in my paper, which is soon to be published; but if this proves what it attempts to prove, namely, that angular peaks have been glaciated, and yet have remained angular, largely because they projected *into* the ice, and that, in one place, in spite of rugged, unsubdued peaks, there is perfect evidence that the ice reached beyond the present land margin, it must overthrow any conclusion concerning former ice extension that is based upon angular topography alone.

A careful detailed study of a single region proves that a land of rugged peaks has been glaciated. Is it then a safe conclusion to draw that the 'ice fell short' o[illegible]f the coast, upon the basis of evidence from angular topography, mainly seen from a ship from five to twenty miles distant? I would go further and ask if, upon such evidence, the conclusion is warranted that the ice did not extend 'out into the heart of Baffin's Bay?' Personally, I draw no conclusion concerning how much of the Greenland coast has been glaciated, nor how far the ice extended; but I do know that ice can override peaks for a long enough time to scour valleys and hillslopes well, and yet leave the peaks rugged and angular in outline; and I also know that the ice in the Upper Nugsuak peninsula region once reached 30 or 35 miles beyond its present margin, which is as far as any evidence can be found in this region. For the larger question, how far it extended, and how much coast it covered, I believe it is well to wait until further evidence is at hand.

RALPH S. TARR.

* Editorial, Journ. Geol., V., 1897, 81.

† Journ. Geol., V., 1897, 95.

‡ Bull. Geol. Soc. Am., 1895, VI., 219.

§ Jour. Geol., IV., 1896, 774.

COMPLIMENT OR PLAGIARISM.

THE second carefully prepared plea of Professors Beman and Smith is simply a conscious

dodging. The case against them is very plain and may be put thus: I offer to pay a year's subscription to SCIENCE for any man, woman or child who will inform the editor of any book in any language where can be found a Section, Partition of a Perigon, or, as Beman and Smith reprint it, Partition of *the* Perigon, and the problems: Problem I., to bisect a perigon; problem II., to trisect a perigon; problem III., to cut (divide) a perigon into five equal parts (angles); problem IV., to cut (divide) a perigon into fifteen equal parts (angles), excepting Halsted's Elements (1885) and Beman and Smith (1895). The question about the word perigon is an issue introduced by Beman and Smith to distract attention from their '*take*.'

But their laborious researches on this matter turn out highly complimentary to me. They find that not a single geometry can be found in any language that ever used this word until after mine. They find, by actual laborious correspondence that W. B. Smith, Newcomb, and even the Italian Faifofer, saw the word for the first time in Halsted's books.

They say, SCIENCE, p. 275: "*We have reason to believe that W. B. Smith, Newcomb and Faifofer all did see the word for the first time in Halsted's books.*" This is all that I have ever claimed about this word, and surely it does me great honor. As to whether I first coined this word, I gave the facts to Cajori (see his 'The Teaching and History of Mathematics in the United States,' 1890, p. 237); but the question for Beman and Smith is whether, like the other geometers, they first saw the word in the only place where any man, before their plagiarism, ever saw the phrase Partition of a Perigon.

GEORGE BRUCE HALSTED.

THE NATIONAL UNIVERSITY: A SUGGESTION.

ON the birthday of Washington this year it has been proposed to bring before as many persons as possible the thought of a National University, with portions of Washington's addresses to Congress, and the clause of his will relating to the subject, in order, to use his own words, 'to set the people ruminating on the importance of the measure as the most likely means of bringing it to pass.'

Relatively few people know that in this document the far-sighted man whom we love to call the Father of his Country bequeathed to the Nation the equivalent of $25,000, in trust as the nucleus for the endowment of such an institution. To-day such an endowment would appear small, but neither principle nor earnings of this sum have ever been applied to the purpose for which it was intended, and had it been kept invested at six per cent. during the century that has all but passed since the testator's death this modest gift would be worth to-day over $12,000,000.

Some sentiment is, no doubt, behind the earnest movement that is now making toward the realization of Washington's hopes, and popular sentiment in a popularly governed country is far from powerless. But the establishment of an educational institution, especially of a university in the proper sense, and above all of a university which is expected to be in fact as well as in name a National University, should depend upon more than popular feeling that the hopes of the broad-minded Washington deserve, even at this late day, to be realized.

When these hopes were formed the country had, in fact, not one university which to-day could justify its use of the name. To-day, among the hundreds of nominal universities, there are scores which offer post-graduate facilities in one or more departments sufficient to justify them in offering advanced degrees, and a few possess an equipment for work whereby the doctor's degree may be earned in either of the principal departments recognized as necessary or desirable for post-graduate work, or university work as contrasted with that which is purely collegiate. Surely these institutions may properly lay claim to the name of university.

Yet, if we possess universities worthy of the name, can it be urged that these are sufficiently numerous, or even sufficiently strong individually, to preclude the desirability of adding to their number one which may hope to do in its every department work equal to that done in the best departments of the best existing institutions? The president* of one of the most

*Jordan, The urgent need of a National University. The Forum, 22: 600, January, 1897.

amply endowed of our colleges does not hesitate to declare for the advisability of the proposed action. He opens his appeal with the statement that 'the most important event in the history of modern Germany has been the foundation of the University of Berlin'—its National University; and he even tells us that the place at the head of our own American educational system is now held by the universities of a foreign land.

True it is that the real scholar who has earned his baccalaureate degree turns to a stronger center than his alma mater, if possible, when he enters upon the struggle for the doctorate; and having taken this, if he deserve it he may sometimes hope for a fellowship from the university that has stamped its official seal on him as a scholar and an investigator, which enables him to pursue his studies still further—not at home, but in foreign universities.

Doubtless, this will always be so. Men, if suitably supported, and not places, make universities; and, with all respect for the learned men who compose the faculty of the Berlin University, it may be said that even the graduate of that great institution finds profit in traveling elsewhere, for help and skill not to be found in Berlin. The practical question is: Are Americans in search of opportunity for advanced study which is not afforded by our existing universities? Are these not increasing in efficiency and capacity in proportion to the growing demand for the best that they can offer? Are there local obstacles in the way of their fullest utilization? Will a National University attract men who need some special inducement to advanced study not now offered? And can it be made to replace the foreign university as the Mecca of our graduate students? Let the university catalogues themselves and the annually collected government statistics answer this in part, nor fear, as some do, that petty ambition and petty jealousy can bias the utterances, on this point, of the officers of any university worthy of the name. Yet, it may well be asked, whatever the answer, who can venture to say that the opening of a National University may not in some real, if not clearly definable, manner appeal to enough men who now stop at the completion of a collegiate course, to justify in the most satisfactory manner its establishment?

If, in my own mind, after trying to view the question impartially, I am not perfectly convinced that there is a real need for a National University, as a center of advanced instruction, I must admit that there may be other more cogent reasons for the attempt now being made to carry Washington's idea into effect; and if, as I cannot help believing, the reasons that influenced his judgment are less weighty to-day than they were a century ago, other reasons, not then revealed, may, perhaps, stand out to-day with greater force than the original reasons ever possessed.

Frequent comment is made, in the scientific press of other nations, on the wonderful liberality of the American government in supporting scientific investigation of our great natural resources. No branch of applied science, or science capable of economic application, is without representation under government auspices. It has been shown recently that no less than 5,225 persons are employed on this scientific and economical work, on which is expended annually nearly $8,000,000.

For some years observing and thinking persons have realized that, great as the value of this work is, it is carried on in too irresponsible and disjointed a fashion to permit of the realization of the greatest possible results, and several more or less successful attempts have been made to secure its partial unification. Quite recently one well fitted to grasp and analyze the situation* has distinctly stated that the time has now arrived when the successful prosecution of the scientific work of the government requires that the various bureaus should be organized in accordance with a logical plan, either under one of the existing governmental departments or in a new department, under the direction of one secretary or executive head.

The scientific bureaus now constitute true university departments in this fundamental respect that they are primarily and preeminently centers of research, manned by investigators.

* Dabney, A national department of science necessary for the coordination of the scientific work of the United States government. SCIENCE N. S. 5: 73, 15 January, 1897.

Nowhere else in the country are men as free to delve into the unsolved mysteries and work out the practical application of discoveries as here. If, as President Jordan asserts,* and as, I think, no one will deny, "The National University should not be an institution of general education, with its rules and regulations, college classes, good-fellowship, and football team; it should be the place for the training of investigators and men of action," can a more favorable plan be formulated, for at once realizing the popular idea of a truly National University and meeting the need for a reorganization and centralization of the National Scientific Departments, than to reorganize the latter as the former, charged with the twofold duty of prosecuting all needful investigation and of training all competent students desirous of devoting their lives to a like purpose? To this scientific foundation, history, literature and the arts would be readily added, without wasteful duplication.

WILLIAM TRELEASE.

SCIENTIFIC LITERATURE.

Die Spiele der Thiere. By KARL GROOS, Professor of Philosophy in the University of Giessen. Jena, Gustav Fischer. 1896. Pp. xvi +359.

In this volume Professor Groos makes a contribution to three distinct but cognate departments of enquiry: philosophical biology, animal psychology, and the genetic study of art. Those who have followed the beginnings of enquiry into the nature and functions of play in the animal world and in children will see at once how much light is to be expected from a thorough-going examination of all the facts and observations recorded in the literature of animal life. This sort of examination Professor Groos makes with great care and thoroughness, and the result is a book which, in my opinion, is destined to have wide influence in all these departments of enquiry.

I cannot take space for a detailed report of Professor Groos' positions. It may be well, therefore, before speaking of certain conclusions which are to me of especial interest, to give a résumé of the contents of the book by chapters. Chapter I. is an examination of Mr. Spencer's 'surplus energy' theory of Play; the result of which is, it seems, to put this theory permanently out of court. The author's main contention is that play, so far from being 'by-play,' if I may so speak, is a matter of serious business to the creature. Play is a veritable instinct, true to the canons of instinctive action. This view is expanded in Chapter II., where we find a fine treatment in detail of such interesting topics as imitation in its relation to play, the inheritance of acquired characters apropos of the rise of instincts, the place and function of intelligence in the origin of these primary animal activities. This chapter, dealing with the biological theory of play, is correlated with Chapter V., later on in the book, in which the 'Psychology of Animal Play' is treated. Together they furnish the philosophical and theoretical basis of the book, as the chapters in between furnish the detailed data of fact. I shall return to the biological matter below. Chapters III. and IV. go into the actual 'Plays of Animals' with a wealth of detail, richness of literary information and soundness of critical interpretation, which are most heartily to be commended. Indeed, the fact that the first book on this subject is, at the same time, one of such unusual value, both as science and as theory, should be a matter of congratulation to workers in biology and in psychology. The collected cases, the classification of animal plays, as well as the setting of interpretation in which Professor Groos has placed them—all are likely to remain, I think, as a piece of pioneer work of excellent quality in a new but most important field of enquiry.

As to the plays which animals indulge in, Professor Groos classifies them as follows: 'Experimenting,' 'Plays of Movement,' 'Play-Hunting' ('with real living booty,' 'with play living booty,' 'with inanimate play booty'), 'Play-fighting' ('teasing, scuffling among young animals,' 'play-fighting among adult animals'), so-called 'Building Art,' 'Nursing' plays, Imitation' plays, 'Curiosity,' 'Pairing' plays, 'Courting by Means of Play of Movements,' 'Courting by the Exhibition of Colors and Forms,' 'Courting by Noises and Tones,' 'Coquetry on the part of the Female.'

l. c. 603.

With this general and inadequate notice of the divisions and scope of the book, I may throw together in a few sentences the main theoretical positions to which the author's study brings him. He holds play to be an instinct developed by natural selection (for he does not accept the inheritance of acquired characters), and to be on a level exactly with the other instincts which are developed for their utility. It is very near, in its origin and function, to the instinct of imitation, but yet they are distinct (a word more below on the relation between play and imitation). Its utility is, in the main, two-fold: First, it enables the young animal to exercise himself beforehand in the strenuous and necessary functions of its life and so to be ready for their onset; and second, it enables the animal by a general instinct to do many things in a playful way, and so to learn for itself much that would otherwise have to be inherited in the form of special instincts; this puts a premium on intelligence, which thus comes to replace instinct (65f.). Either of these utilities, Professor Groos thinks, would insure and justify the play instinct; so important are they that he suggests that the real meaning of infancy is that there may be time for play.*

It is especially in connection with this latter function of play that the instinct to imitate comes in to aid it. Imitation is a real instinct, but it is not always playful; play is a real instinct, but it is not always imitative. Professor Groos does not suggest, I think, closer relations between these two instincts. There is likely, however, to be a great deal of imitation in play, since the occasion on which a particular play instinct develops is often that which also develops the imitative tendency as well, *i. e.*, the actual sight or hearing of the acts and sounds of other animals. Moreover, the acquisition of a muscular or vocal action through imitation makes it possible to repeat the same action afterwards in play.

It is only a step, therefore, to find that imitation, as an instinct, has to have ascribed to it, in a measure, the same race utility as play—that of going before the intelligence and preparing the way for it, by rendering a great number of specialized instincts unnecessary. It is interesting to contrast this view with that which the present writer has recently developed in these pages (Science, March 20, 1896), *i. e.*, the view that imitation supplements inadequate congenital variations in the direction of an instinct and so, by keeping the creature alive, sets the trend of further variations in the same direction until the instinct is fully organized and congenital. If both these two views be true, as there seems reason to believe, then imitation holds a remarkable position in relation to intelligence and instinct. It stands midway between them and aids them both. In some functions it keeps the performance going, and so allows of its perfection as an instinct; in others it puts a stress on intelligence, and so allows the instinct to fall away if it have no independent utility in addition to that served by intelligence.* In other words, it is through imitation that instincts both arise and decay—that is, some instincts are furthered and some suppressed, by imitation. And all this is accomplished with no appeal to the inheritance of acquired characters, Professor Groos agreeing with Weismann that the operation of natural selection as generally recognized is sufficient.

The difficulty which I see to this conception of play as a pure instinct is that which is sometimes urged also against considering imitation an instinct, *i. e.*, that it has no definite motor coordinations, but has all the variety which the different play forms show. If the definite congenital plays are considered each for itself, then we have a great many instincts, instead of a general play instinct. But that will not do, for it is one of Professor Groos' main contentions, in the chapter on the psychology of animal plays, that they have a common general char-

* "Die Thiere spielen nicht weil sie jung sind, sondern sie haben eine Jugend, weil sie spielen müssen" (68). Other capital utilities which might be added are (1) the exercise of the intelligence itself and (2) direct *social* utility as such.

* In a private communication Professor Groos suggests to me that the two views might be held to supplement each other. The case is very much like that of early intelligence, in the form of association; where it fully accomplishes the utility also subserved by an instinct, it tends to supersede the instinct; otherwise, it tends to the development of the instinct (Groos, p. 64).

acter which distinguishes them from other specialized instinctive actions. They are distinguished as play actions, not simply as actions. This difficulty really touches the kernel of the matter, and serves to raise the question of the relation of imitation to play; for imitation presents exactly the same conditions—a general instinct to imitate, which is not exhausted in the particular actions which are performed by the imitation. I shall remark on the solution of it below, in speaking of Professor Groos' psychology of play. It will be interesting to see how he treats this problem in his promised work on the *Spiele der Menschen;* for the imitative element is very marked in children's plays.

Other points of great interest in this biological part are the great emphasis which Groos finds it necessary to put on 'tradition,' instruction, imitation, etc., in young animals, even in enabling them to come into possession of their natural instincts; in this the book tends in the same direction as the new volume of Professor C. Lloyd Morgan. Again, there is a remarkably acute discussion of Darwin's Sexual Selection, which the author finally accepts in a modified form by saying that the female's selection is not necessarily conscious, but that she has an inherited susceptibility to certain stimulating colors, movements, etc., in the male. It is not so much intelligence on her part as increased irritability in the presence of certain visual and other stimulations. *Over against the charms of the male he sets the reserve or reluctance (*Sprödigkeit*) of the female, which has to be overcome and which is an important check and regulator at the mating time. Again, the imperfect character of most instincts is emphasized, and the interaction with imitation and intelligence. He finds a basis for the inverse ratio between intelligence and instinct is an animal's equipment on natural selection principles, *i. e.*, the more intelligence develops the less does natural selection bear on special instincts, and so they become broken up.

* 'Sexual' is thus referred back to 'natural' selection (p. 274), although the direct results of such preferential mating would still seem to give very 'determinate' variations for natural selection to work upon (*Cf.* SCIENCE, Nov. 23, 1896, p. 726).

Finally, I should like to suggest that a possible category of 'Social Plays' might be added to Groos' classification—plays in which the utility of the play instinct seems to have reference to social life as such. Possibly in such a category it might be possible to place certain of the animals' performances, which seem a little strained under the other heads—for example, those performances in which the social function of *communication* is exercised early in life. A good deal might be said also in question of the author's treatment of 'Curiosity' (*Neugier*). He makes curiosity a function of the attention, and finds the restless activity of the attention a play function, which brings the animal into possession of the details of knowledge before they are pressed in upon him by harsh experience. My criticism would be that attention does not fulfil the requirements of the author's psychological theory of play, as indicated below.

Turning now to the interesting question of the psychological theory, we find it developed, as it would have to be, in a much more theoretical way. The play consciousness is fundamentally a form of 'conscious self-illusion' (311 ff)—*bewusste Selbsttäuschung.* It is just the difference between play activity and strenuous activity that the animal knows, in the former case, that the situation is not real, and still allows it to pass, submitting to a pleasant sense of illusion. It is only fair to say, however, that Herr Groos admits that in certain definite instinctive forms of play this criterion does not hold; it would be difficult to assume any consciousness of self-illusion in the fixed courting and pairing plays of birds, for example. The same is seen in the very intense reality which a child's game takes on sometimes for an hour at a time. Indeed, the author distinguishes four stages in the transition from instincts in which the conscious illusion is absent, to the forms of play to which we can apply the phrase 'Play activity' in its true sense, *i. e.*, that of *Scheinthätigkeit* (298 f). The only way to reconcile these positions that I see is to hold that there are two different kinds of play: that which is not psychological at all, *i. e.*, does not show the psychological criterion at all, and that which is psychological as *Scheinthätigkeit.* Herr Groos does

distinguish between 'objective' and 'subjective' *Scheinthätigkeit* (312). The biological criterion of definite instinctive character might be invoked in the former class, and the psychological criterion in the other. And we would then have a situation which is exemplified in many other functions of animal and human life—functions which are both biological and instinctive, and also psychological and intelligent, as sympathy, fear, bashfulness. Then, of course, the further question comes up as to which of these forms is primary, again the old question as to whether intelligence arose out of reflexes or the reverse.

I think some light falls on this time-honored question from the statement of it in connection with this new question of play, and especially when we remember Herr Groos' theory of the function of imitation and the extension of his view suggested above. If imitation stands midway between instinct and intelligence, both furthering the growth of instinct, and also leading to its decay in the presence of intelligence, then we might hold something like this: In proportion as an action loses its consciously imitative and volitional character, to that degree it loses its *Schein* character, and becomes real in consciousness and instinctive in performance (and this applies to the cases in which imitation has itself become habitual and instinctive); and on the contrary, in proportion as an instinctive action is modified and adapted through imitation and intelligence, to that degree it becomes capable of assuming the *Schein* character and is indulged in as conscious play. I cannot enlarge upon this here, but it seems to square with a good many of the facts, both those which Groos cites as showing that imitation opens the way for the decay of instinct with the growth of intelligence, and those which Morgan and I have cited as showing that imitation keeps congenital variations alive and so allows them to accumulate into instincts. And I think it so far confirms the view that imitation is a sort of meeting point of race habit, represented by instinct, and race accommodation, represented by intelligence—just the double function which imitation serves also in the development of the individual (*Cf.* My volume on *Mental Development*, in loc.).

Going into the analysis of the play psychosis, Herr Groos finds several sources of pleasure to the animal in it (203 ff): pleasure of satisfying an instinct, pleasure of movement and energetic action, but, most of all, 'pleasure in being a cause.' This last, together with the 'pleasure in experimenting,' which characterizes many play activities, is urged with great insistence. Even the imitative function is said to produce the joy of 'victory over obstacles.' Yet, here again, the author is compelled to draw the distinction between the play which is psychological enough to have a represented object, and the instinctive sort in which the pleasure is only that of the instinct's own performance. The pleasure of overcoming friction of movement, also, is very doubtful, since in any but the instinctive games which are cited (Chapter I.) to prove that the animal is not using up surplus energy (seeing that he plays after he is tired)—in other games we stop playing when the friction and inertia of the muscles become conscious as fatigue. Much more, however, is to be said for the pleasure of rivalry, or of overcoming an opponent, in the higher types of play; but Herr Groos scarcely does this justice.

Returning to the element of illusion in play, we find two ingredients in it (313 ff): a division of consciousness (*Spaltung des Bewusstseins*), *i. e.*, a division between the activity treated as real and the sense that it is unreal. There is considerable oscillation between these two poles. This ability to treat representations as realities is, according to Herr Groos, the essential of all imagination. In play it is akin to the division of consciousness found in certain pathological cases of double personality. It is a sort of hypnotization by the stream of representations, but with the sense that it is all an illusion and may be pierced through by a return to reality at any moment. This seems to me a true and valuable characterization of the play consciousness (it is taken from K. Lange), but Professor Groos' extension of it to all imagination does not seem to hold. In his criticisms of others (as the present writer) he fails to honor the current distinction between 'fancy' and 'constructive imagination.' In fancy we do yield ourselves up to a play of images, but

in the imagination of scientific thinking or of artistic creation are not both the goal and the process strenuous enough? This, indeed, leads Professor Groos to a view of art which allies it closely with the play function, but to that I return below.

The second element in the play or '*Schein*' consciousness is the feeling of freedom (*Freiheitsgefühl*) (331f). In play there is a sense, so to speak, of 'don't-have-to,' which is contrasted both with the necessity of sense and with the imperative of thought and conscience. This idea seems to be part of Schiller's theory of play. So Groos thinks the general feeling of freedom holds in consciousness only while there is a play of motives to which the agent may put an end at any moment—a sense of 'don't-have-to' in the life of choice. This sense of freedom keeps the *Schein* consciousness pure and prevents our confusing the play content with the possible real contents of life. This is very interesting and suggestive. The sense of freedom is certainly prominent in play. Whether it should be identified with the sense of control which has been used by some writers as a criterion (both in a negative and in a positive sense) of the belief in realities already experienced, or again with the freedom with which choice is pregnant, is more questionable. Without caring to make a criticism of Professor Groos' position, I may yet point out the distinction already made above between the two sorts of imagination, one of which has the 'don't-have-to' feeling and the other of which does not. So also in our choices there are those which are free with a 'don't-have-to' freedom, but there are choices—and these are the momentous ones, the ones to which freedom that men value attaches—which are strenuous and real in the extreme. Indeed, it seems paradoxical to liken the moral life, with its sense of freedom, to a 'game of play,' and to allow the hard-pressed sailor on the ethical sea to rest on his oars behind a screen of *Schein* and plead, 'I shan't play.' Seriously, this is something like the result, and it comes out again in the author's extremely interesting sections on art, of which I may speak in conclusion.

Those who have read Professor Groos' former stimulating book, *Einleitung in die Æsthetik*, will anticipate the connection which he finds between play and art. The art consciousness is a consciousness of *Schein*; it is also a play consciousness, inasmuch as it is the work of imagination—both the creative and the appreciative art consciousness—and the meaning of imagination is just that it takes *Schein* for reality. The 'self-conscious' illusion of the play consciousness is felt in extreme form in the theatre, and the pleasure of it is felt even when we play with painful situations, as in tragedy. In art the desire to make an impression on others shows the 'pleasure of being cause.' This intent to work on others is a necessary ingredient in the art impulse (312f). Groos differs from K. Lange, who holds a similar view of the necessary division of consciousness between reality and *Schein* in the æsthetic psychosis, in that Lange thinks there must be a continual oscillation between the two poles of the divided consciousness, while Groos thinks there is rather a settling down in the state of illusion (as in an artist's preoccupation with his creations, a novelist with his characters, and a child with her doll (323). In art the other great motive of play, 'experimenting,' is also prominent, and is even more fundamental from a genetic point of view; of that a word below.

Here, again, the question left in my mind is this: whether the play motive is really the same as the art motive. Do we not really distinguish between the drama (to take the case most favorable to the theory) as amusement and the drama as art. And does the dramatist who is really an artist write to bring on self-illusion in the spectator by presenting to him a *Schein* scene. Possibly, art theorists would divide here; the realists taking more stock in *Schein*, since realistic art is more nearly exhausted by imitation. This sort of illusion undoubtedly gives pleasure, and it is undoubtedly part of art pleasure. Yet there does seem to be, in a work of fine art, a strenuous outreach toward truth, which is additional to the instrument of appearance used by the artist—both in the production and also in the enjoyment. It may be that we should distinguish between truth which comes to us didactically and truth which comes artistically, and make

the method of the latter, and that alone, the source of æsthetic impression. In any case the theory of Groos, which has its roots in the views of Lange and v. Hartmann, is extremely interesting and valuable, especially as contrasted with the recent psychological theory of Mr. H. R. Marshall. In the present theory, the 'self-exhibition' of which Mr. Marshall makes so much, enters as the need of impressing others with the play illusion. As to the hedonic element and its ground, however, the two theories are in sharp contrast, and that of Groos seems to me, on the whole, more adequate. In the wealth of literary reference in his book Mr. Marshall pays singularly little attention to the authors from whom Groos draws, and none to the earlier work of Professor Groos himself, but treats the play theory only in the form of Mr. Spencer's surplus energy construction. As to Groos' theory musical art would present difficulties and so would lower sensuous æsthetic effects generally.

Genetically art rests upon play, according to Herr Groos, in that the three great motives of art production, 'Self-exhibition' (*Selbstdarstellung*), 'Imitation,' and 'Decoration' (*Ausschmückung*), are found in the three great classes of animal plays, respectively, 'Courting,' 'Imitation,' and Building Art' (*Baukünste*, seen in birds' nest-building, etc.). On the strength of this, Groos finds both æsthetic appreciation and impulse in the animal, and all rests upon the original 'experimenting' impulse. Of this, however, Professor Groos does not give a satisfactory account. Experimenting is a necessary part of effective learning by 'imitation,' I think, and the use made of it in the selection of movements may be its original use.

On the whole, Professor Groos' book is both a pioneer work and one of great permanent value; it should be translated into English. It contains a good index and a full list of the literary sources.

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Princeton.

A Primer of the History of Mathematics. By W. W. Rouse Ball. London, The Macmillan Co. 1895. Pp. 148, 16mo. Price, 65 cents.

A History of Elementary Mathematics, with hints on methods of teaching. By Florian Cajori. New York, The Macmillan Co. 1896. Pp. viii+304, 12mo. Price, $1.50.

The object of the 'Primer,' as well set forth in its introduction, is "to give a popular account of the history of mathematics, including therein some notice of the lives and surroundings of those to whom its development is mainly due, as well as their discoveries. Such a sketch, written in non-technical language and confined to less than 140 pages, can contain nothing beyond a bare outline of the subject, and, of course, is not intended for those to whom it is familiar." It consists of the author's larger work* reduced in size by the omission of all detailed and highly technical matter. In a few places the pruning process has been carried too far. For example, on p. 13 we are told that "after the execution of Socrates, in 399 B. C., Plato spent some years in travel * * * " but we are given no clue to the relationship of Socrates to Plato. However, the few instances of this kind which occur do not appreciably detract from the clear, well ordered and interesting style which the 'Primer' enjoys in common with its source.

The book affords to students in our high schools and colleges a means of gaining, with a small expenditure of time, a sufficiently complete history of the mathematical subjects they are studying, to give them a much greater appreciation of and interest for such subjects.

As its title indicates, Professor Cajori's book does not cover the entire field of mathematics; he restricts it to arithmetic, algebra, geometry and trigonometry, as presented in undergraduate instruction, with a short account of the history of non-Euclidean geometry. The arrangement of the material is first under the headings: 'Antiquity,' 'Middle Ages,' 'Modern Times;' under each of these are the subdivisions: 'arithmetic,' 'algebra,' 'geometry' and 'trigonometry.' For a work of its size it contains a great deal of information, and nearly every statement is supported by a reference either to original sources or to other treatises upon mathematical history. The chapters upon arithmetic are par-

*A short account of the History of Mathematics. London, the Macmillan Co. 2d edition. 1893. Pp. xxiv+520, 16mo.

ticularly rich in examples of methods of calculating which have long since disappeared from our arithmetics, and, as the author points out, some of these are, by no means, inferior to those now used. Such examples make the history of arithmetic very real to one. The sections entitled 'Causes which checked the growth of demonstrative arithmetic in England,' 'Reforms in arithmetical teaching,' and 'Arithmetic in the United States,' show forcibly the stagnation which results in regarding it not as a demonstrative science, but merely as an art of calculation.

The accounts of modern synthetic geometry and of non-Euclidean geometry (pp. 252–275) seem well chosen. It is necessary for teachers of geometry to have a broader view of their subject than is afforded by the typical text-book.

Having called attention to some of the merits of Professor Cajori's work, it is unfortunately necessary now to note some of its defects. The inconvenient method of introducing an abbreviation, the first time a work is cited, to be used for it subsequently, we trust will in future editions be remedied by a table at the end of the volume. It is confusing, if one is not certain of their identity, to have 'Ptolemy' and 'Ptolemæus' used indiscriminately. In the statement that "$\sqrt{2}$ cannot be exactly represented by any number whatever" (p. 51), the word rational has, of course, inadvertently been omitted. Foot-note 3, p. 72, is very indefinite in its present form. Referring to remarks at the top of page 74, we quite agree with the author that rigor in geometry demands the proof of the *possibility* of all constructions before they are used. For example, that the circumference of a circle admits of being divided into any number of equal parts should be shown (which involves no difficulty) before considering regular inscribed polygons in general. The example of the text leads one to suppose that rigor demands our ability to construct (subject, in fact, to the arbitrary condition of having only ruler and compass) every inscribed polygon we may wish to use.

The material of the volume in places shows lack of coordination and incomplete moulding into an organic whole. One feels at times lost in a maze of fact. We are given part of the biography of Leonardo of Pisa on page 119 and part on page 134. The origin of the word 'sine' is found on page 124 and again on page 130. On page 75 and again on page 78 we are told of the tomb of Archimedes.

In the foot-note 1, page 160, the conclusion that the base of Napier's logarithms is e^{-1} is erroneous, and it does not follow from what precedes it. If we define the logarithm of x with respect to the constant base b, by the equation $x = b^{\log x}$, then the numbers discovered by Napier are not logarithms; but if b is not restricted to be constant, the above equation defines Napier logarithms when

$$b = 10^{\frac{7}{\log x}} \div C^{\left(\frac{1}{10}\right)^7}$$

(Hagen, Synopsis der hoeheren Mathematik I., p. 107.) To define the base of Napier's logarithms as the number whose logarithm is unity is in this case misleading. The term is, however, so used by Cantor (Geschichte der Mathematik, II., p. 672), who gives its value to be

$$10^7 \div C^{\left(\frac{1}{10}\right)^7}$$

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Die Bedingungen der Fortpflanzung bei einigen Algen und Pilzen. Von DR. GEORGE KLEBS. Jena, Gustav Fischer. 1896. Pp. i.+543, 3 plates.

This work of Dr. Klebs' is an important contribution to the physiology of reproduction. As its title indicates, the experiments were conducted for the purpose of determining the conditions of reproduction in certain algæ and fungi. A preliminary account of some of this work has been published in earlier contributions. The earlier experiments have been amplified and extended to a number of additional plants, and the present work details carefully his later experiments and presents the philosophy and deductions of all his work upon this topic. It is a remarkable work, alike for the painstaking conduct of the experiments, the precautions against error, the important results obtained and the cautious generalizations upon the relations of the different kinds of reproduction to environment. Not only is the work one of great interest to the student of develop-

ment and to those interested in the theoretical questions of reproduction, but it is one which will be a great aid to teachers who wish to supply material of these lower forms of algæ to their classes in a condition in which these processes of reproduction can be observed. This is especially so in the case of certain species of *Vaucheria*, *Hydrodictyon*, *Oedogonium* and others, since the conditions have been determined under which one can with certainty bring the material to the production of zoospores, or to the development of sexual organs within a reasonable limit of time.

His most extended experiments were conducted upon species of *Vaucheria*, especially upon *Vaucheria repens*, *clavata* and *sessilis*, or upon the composite species *Vaucheria sessilis*, as some would treat it. Klebs would, however, treat these three forms as species, and it is interesting to see how the reactions of these three forms toward various conditions of environment and artificial treatment give support to the view that they may be regarded as species, and we are promised a thorough-going revision of the species of *Vaucheria* from the hand of one of Dr. Klebs' students.

The experiments cannot be given in detail, but under the head of the asexual reproduction through zoospores the methods employed were similar to those noted in 1892. Plants cultivated in the light and in moist atmosphere, on being transferred to water produce numerous zoospores; cultivated in a 0.2 per cent. to 0.5 per cent. nutrient solution (inorganic salts) in the light, on being transferred to pure water produce zoospores. On the other hand, cultures in water, or in a 0.1 per cent. to 0.2 per cent. nutrient solution, produce zoospores on simply being darkened. The development is especially active when the first or second method is combined with the third. In studying the conditions which influence sexual reproduction he found *Vaucheria repens* the best subject, though any of the species studied could be brought with certainty in artificial cultures to form sexual organs. For example, threads of *Vaucheria repens* placed in a 0.2 per cent. to 0.4 per cent. cane-sugar solution form sexual organs with the greatest certainty in four to five days. In studying the influence of light he found that it acts in a two-fold manner. Through the assimilation of CO_2 reserve material, in the form of organic compounds, which is necessary for sexual reproduction, is supplied, and the light also acts in a direct way stimulating the process. This was proved by growing cultures under conditions where an abundance of light was supplied, but the plants were deprived of the CO_2 of the air, so that none or little carbon assimilation took place and no sexual organs were formed. Cultures, under similar conditions, in a cane-sugar solution, produced sexual organs, the reserve material here being supplied by the sugar solution. On the other hand, cultures in a cane-sugar solution in weak light or in darkness produced no sexual organs. The same results were obtained in cultures of other genera of algæ, and his conclusions that light acts in a twofold manner seem justified.

In studying the conditions which influence the male or female organs some interesting results were obtained, though no definite conclusions were reached regarding the relation between these two kinds of organs. Cultures in a thermostat at 25° to 26° C. showed a tendency to complete suppression of the oogonium or to a vegetative growth of the same, the number of oogonia in a group being not incresed, while the antheridia were increased in number in some cases as much as five- to seven-fold. Cultures under air pressure of 120 mm. gave similar results.

In his studies of *Drapernaudia glomerata* he discovered microzoospores and observed their conjugation to form zygospores. Pringsheim, in 1860, first observed resting cells, and speaks of the formation of microzoospores, though he does not describe them. Klebs first observed them in 1894. Algæ were taken from a cold standing culture and placed in a 2 per cent. cane-sugar solution in the heated laboratory. After twenty-four hours zoospores were formed, and after forty-eight hours microzoospores appeared. The microzoospores are oval to spherical and about half the size of the zoospores, and are four ciliate. The red-eye spot is near the base of the body while in the zoospores it is situated at the upper third. Many of the microzoospores form resting spores parthenogenetically, though, as stated above, Klebs was

able to observe certain of the resting cells formed by the conjugation of two microzoospores.

In his studies upon *Botrydium granulatum* he determined by pure cultures that what has been regarded as a remarkable pleomorphic species really represents two distinct species. His attention was first called to this confusion by the difference in the cell structure of the various forms. In one the chlorophyll bodies are in the form of distinct discs, while in the other the chlorophyll is a single connected plate. In one the cells form a fatty oil but no starch, while the other possesses amylon grains and starch bodies, their structure being like that of the cell of Hydrodictyon. One of these plants is a true *Botrydium*, while the other is the *Protococcus botryoides*, described by Kuetzing in 1845, and in 1855 Cienkowski correctly described its development. Since the genus *Protococcus* is untenable, Klebs proposes the name of *Protosiphon botryoides* for this plant.

He takes occasion to deplore the tendency of some algologists to repeat in the case of the algæ the pleomorphic craze which once brought such confusion to bacteriology and mycology, citing especially Hansgirg, in 1855, and the more recent work of Borzi and Chodat, who claim to have connected a large number of genera in the form cycle of one species. He points out that these investigators did not use pure cultures and were thus led to include in the form cycle different genera appearing in the culture. It has been held by some that if filamentous algæ possess protococcoid forms in one stage of development, then all protococcoid forms are states of filamentous algæ. It is impossible to distinguish the swarming gametes of Chlamydomonas and Ulothrix, still it does not follow that Chlamydomonas belongs to Ulothrix. He insists that in studies of development pure cultures should be used, though pure cultures in the sense in which they are made in bacteria and the fungi cannot be made. Pure cultures and continuity of observation, especially in connecting different stages, should be substituted for mixed cultures and discontinuous observations.

Space will not permit a discussion of his experiments upon other genera of *algæ* and the *fungi*, but the following outline of his experiments upon *Vaucheria* will give an idea of the thorough and comprehensive manner in which his work was conducted.

I. The asexual reproduction through zoospores of *Vaucheria repens* and *clavata*.
  1. Influence of nourishment.
  2. Influence of dampness.
  3. Influence of light; of darkness; of weak light; of the rays of the spectrum; of light intensity; of carbon assimilation.
  4. Influence of temperature; low temperature; high temperature; mean temperature and variations of temperature.
  5. Influence of the chemical peculiarities of the medium.
    A. Inorganic compounds; effect of nutrient salts; change from nutrient salts to water.
    B. Organic compounds; cane sugar; camphor.
    C. Osmotic value of the compounds.
    D. Influence of acid or alkaline reaction.
    E. Influence of oxygen; influence of air pressure; of rarified air.
    F. Influence of flowing water; of friction; of temperature; of oxygen and nutrient salts.

II. The asexual increase in the case of other species of *Vaucheria: Vaucheria ornithocephala;* aplanospores of *V. geminata;* conditions of their formation; aplanospores of *V. racemosa, uncinata.*

III. The sexual reproduction of *Vaucheria.*
  1. Influence of light.
    A. Effect of light as a means of nourishment.
    B. Influence of light intensity.
    C. Significance of colored light.
  2. Influence of dampness.
  3. Influence of temperature.
  4. Influence of chemical peculiarities of the medium.
  5. Influence of oxygen.
  6. Influence of flowing water.
  7. Upon the relation of the male and female sex.

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Codice Messicano Vaticano, No. 3773. EDIZIONE DEL DUCA DE LOUBAT. Roma. 1896.

In the native literature of America that which was the product of aboriginal authors, the pictographic manuscripts, or 'codices,' as they are called, of Mexico and Central America, hold the first rank. Quite a number of them, though generally in an imperfect condition, have been preserved which date from before the

conquest of the country by Europeans. Most of these are the work of tribes speaking either the Nahuatl (Aztec) or the Maya languages; but others are from the Zapotec or Mixtec regions, these representing different linguistic stocks.

The accurate reproduction, by modern methods, of these remarkable monuments of a perished civilization is one of the most valuable services which can be rendered to the study of American archæology; and in presenting in all respects a fac-simile of one of the most perfect, the Codex Vaticanus No. 3773, the Duke de Loubat has added another and a most important item to his many claims on the gratitude of those interested in the ancient history of America. His edition leaves nothing to be desired in point of faithfulness to the original; and that it is in fact a gift to science, being chiefly distributed to public libraries, excites just admiration for the liberality as well as the appreciative scholarship of the donor.

The Codex in this edition is accompanied by two articles from the pen of the well-known archæologist, Father Francisco del Paso y Troncoso, one on the proper sequence of the pages of the manuscript, the other on its probable age and origin. The former is indispensable to its comprehension.

This Codex was included by Lord Kingsborough in his great work published in 1831; but not only was the copy prepared by his artist defective in various particulars, but its pages were erroneously arranged, so that the study of it became hopelessly confusing.

From what is know of the classes of native writings, this Codex is recognized as of Nahuatl origin and is concerned with the ritual year of 260 days, doubtless either in its divinatory applications, or as regulating the fasts, festivals and other religious ceremonies of the temples. The opening pages give the *tonalamatl*, or list of days, and on the last is the picture of a masked figure indicating the astrological relationship of the various parts of the body.

As we have in the 'Borgian Codex' a document from the same locality, and also ritual in its character, there are facilities for the explanation of this Vatican Codex not to be found in other instances.

So far as its history is concerned it rests in obscurity. It was certainly in the Vatican library as early as 1596, and may have reached there about 1550. But, of course, no question can be raised concerning its authenticity, and its composition previous to any European influence in Mexico. We thus have, by the generous action of M. de Loubat, placed within the reach of students probably the best conserved example of that once rich native literature in which were stored the history, religion and science of aboriginal American civilization.

D. G. Brinton.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, FEBRUARY.

A Contribution to the Study of Water Solutions of Some of the Alums: By H. C. Jones and E. Mackay. Various methods have been used in investigations of the conditions existing in a solution from which double salts will crystallize out. The question to be decided was whether the double salt was present as such in solution, or was formed at the moment of crystallization. The methods used may be grouped under the following heads, as they have to do with (*a*) the diffusion, (*b*) the thermal changes, (*c*) the volume changes, (*d*) the solubility, (*e*) the electrical properties, or (*f*) the cryoscopic behavior of solutions of the compounds under investigation. After reviewing these methods the authors state that the aim of the present work was to obtain, from a study of the conductivity of solutions of alums, data which would justify more definite conclusions than had yet been drawn. They have compared the electrical conductivity and cryoscopic behavior of the double salts with that of their constituent salts to see if they corresponded to mixtures. The methods of work, analyses and preparation of various alums are given. The results obtained by the conductivity method show that in dilute solutions the complex alum molecules are broken down completely into the molecules of the simpler sulphates, which dissociate as if alone, while in more concentrated solutions the alums are either partially undecomposed or the dissociation is not complete. Potassium chrome alum apparently exists as such in moderately concentrated

solutions. These results in general are confirmed by the freezing point measurements.

Silicides of Copper and Iron: By G. DECHALMOT. In a former number of this journal the author described a silicide of copper of the composition Cu_2Si_3. Upon repeating the work with different specimens he found that the substance obtained was a mixture of silicon, copper silicide and copper. The mixture forms apparently homogeneous pure crystals, which fact led him to think they were of the composition given above. He has also obtained a silicide of iron to which he gives the composition $FeSi_2$.

Formation of Diacetylenyl (Butadiine) from Copper Acetylene: By A. A. NOYES and C. W. LUCKER. Several investigators have described a crystalline product obtained by the action of acetylene (from copper acetylene) on boiling bromine. The composition ascribed to it was $C_4H_2Br_6$, and the present investigation was undertaken to verify this and to determine the origin of the compound. Pure acetylene (from calcium carbide) would not produce it, and it was finally discovered that the action would take place more readily if cupric chloride was added to the copper acetylene before its decomposition, as the formation was due to the oxidizing action of the cupric chloride formed by the action of the air on the copper acetylene and hydrochloric acid. The study of the compound led to the conclusion that it is formed by the direct union of the hydrocarbon C_4H_2 with bromine.

On the Action of Acid Chlorides on the Imido Esters and Isoanilides, and on the Structure of the Silver Salts of the Anilides: By H. L. WHEELER and P. T. WALDEN. The authors thought that light might be thrown on the constitution of the silver salts by the study of the action of acid chlorides on compounds that are definitely constituted as the silver salts are supposed to be. From the action of acid chlorides on isoanilides and imido esters results were obtained which admit of only one interpretation according to which the reactions are explained, not by tautomerism, but by addition. This proves also that the metal in the silver salts of the anilides is directly joined to oxygen. The reactions of acid chlorides with imido esters also showed that diacid amides have both acid groups attached to the nitrogen. These results were further confirmed by the action of the halogens on the imido esters.

On the Effect of Light on the Displacement of Bromine and Iodine from Organic Bromides and Iodides: By J. H. KASTLE and W. H. BEATTY. In studying the decompositions of the halogen derivatives of the sulphonamides it was found that the halogen was set free, to a considerable extent, by the action of sunlight. If a substance containing both chlorine and bromine is exposed to the sunlight in a sealed tube with water the chlorine is first set free, and after some time, from the action of this chlorine, the bromine is set free. Chlorine set free in this way could displace bromine and iodine from their most stable compounds. Parallel experiments carried on in the sunlight and in the dark showed that up to 50° no change took place in the dark, while the action in the light was marked.

The Specific Gravities of Water Solutions of Formic Acid: By G. M. RICHARDSON and P. ALLAIRE. The authors have determined the specific gravity of solutions of formic acid, making seventy-one determinations between the pure acid and a solution containing only 0.618 per cent., and have tabulated the data obtained.

The Constitution of Benzanilide: By N. KNIGHT. There are two possible formulæ for benzanilide, and a method which was suggested to establish the correct one was to study the reactions of benzene sulphanilide with benzoylchloride and of benzanilide with benzenesulphonchloride. The results, however, were different from those expected, dibenzoylanilide being the chief product, and no important conclusions as to the structure could be drawn.

A number of recent publications are also reviewed in this number of the *Journal*, viz.: *Traité de chemie organique d'après les theories modernes*, A. BÈHAL; *Analytical Chemistry*, N. MENSCHUTKIN; *Recherches sur la congelation des solutions aqueuses étendues*, M. A. PONSOT; *Kurzes Lehrbuch der organischen Chemie*, A. BERNTHSEN; *Studies in Chemical Dynamics*, J. H. VAN'T HOFF; *The Chemical Analysis of Iron*, A. A. BLAIR (3d edition); and *Gas and Fuel Analysis for Engineers*, A. H. GILL.

J. ELLIOTT GILPIN.

THE JOURNAL OF COMPARATIVE NEUROLOGY, DECEMBER, 1896. DOUBLE NUMBER.

The Brain of the Bee—A Preliminary Contribution to the Morphology of the Nervous System of the Arthropoda: By F. C. KENYON, Ph.D., Clark University. This memoir contains the first really successful and comprehensive application of modern methods to the central nervous system of the insects. Dr. Kenyon was very successful with the newer silver and hæmatoxylin methods, though the difficulties in this research were very great. This communication contains a detailed description of the structure, especially the fiber connections, of the brain of the honey bee, with the exception of the optic lobes, which are reserved for separate treatment. Thirty-two cell groups are enumerated and their connections given so far as known. The text comprises 78 pages and there are nine plates, three of photographs, two of silver preparations and four charts in colors showing the courses of the fibers in detail. Among the results perhaps the most interesting relates to the structure of the so-called mushroom bodies. Additional evidence is adduced to show that the function of these peculiar bodies is that of enabling the insect to intelligently adapt itself to its surroundings. They are shown to be connected at their calices with two pairs of sensory tracts of fibers from the optic lobes, with three from the antennal lobes and with one that is probably also sensory from the ventral nervous system. Their roots are shown by fragmentary evidence, sufficient to warrant the conclusion, to be very probably connected with the inner terminals of motor, or possibly of other efferent fibers.

The Origin and Growth of Brain Cells in the Adult Body: By HOWARD AYERS. The recent discovery of the centrosome in both vertebrate and invertebrate nerve cells has brought into prominence anew the question as to whether the current doctrine that adult nerve cells do not divide is true. It will be remembered that Herrick and others have long claimed that it is not, and now Dr. Ayers brings forward fresh evidence. In the brain of the adult Torpedo he finds cells dividing in a very characteristic manner and these are especially abundant in the electric lobes. The centrosome was found, but the division is apparently amitotic. In the electric lobes there is also another remarkable feature. The overgrown ganglion cells have applied themselves to the walls of the arterial capillaries and there spread themselves out, thus affording the best possible facilities for nutrition.

The Innervation of the Auditory Epithelium in Mustelus canis DeKay: By A. D. MORRILL. This paper gives a summary of the results of some very successful methylen blue preparations of the ear of the smooth dog-fish. No continuation of the nerve into the cell was observed, although the cells were semi-transparent. Satisfactory evidence of anastomosis of nerve fibers was not obtained. There are two kinds of nerve endings in the auditory epithelium, the one being free near the surface, and the other ending in knob-like structures in contact with the base of the hair cells.

Neural Terms, International and National: By BURT G. WILDER, M. D., Cornell University. In this extensive paper of 136 pages Dr. Wilder has brought together the main points in his voluminous writings on nomenclature, together with much new matter, and has arranged the whole in the form of a systematic presentation of the principles of nomenclature and their application to the nervous system, which should be a standard of reference for many years to come. The immediate occasion of the paper is the report of the Committee on Anatomical Nomenclature of the Anatomische Gesellschaft, Basel, 1895. As this German committee is to report again after three years, it is very desirable that in the meantime all questions of nomenclature should receive careful attention. The paper contains a valuable list of definitions of terms employed in the discussion, a review of the author's work on nomenclature, full discussions on the reports of the American and German committees and extensive comparative tables of terms of brain anatomy, together with a bibliography.

AMERICAN GEOLOGIST, FEBRUARY.

A TRIBUTE to Professor Ch. Fred. Hartt, By Frederic W. Simonds.

Dr. F. W. Sardeson continues his correlation studies on the Galena and Maquoketa

series. In this paper he discusses the species commonly known as *Orthis testudinaria*, and concludes that several separate forms are generally comprised in it and that the original species has no typical American representative.

Professor Jules Marcou finishes his review of 'Rules and Misrules in Stratigraphic Classification.' Especial application is made to various members of the Orodovician, Mesozoic, Tertiary and Quaternary. In a postscriptum the three official geological maps of the State of New York are compared in some detail.

The extreme rapidity of weathering and stream erosion in the artic latitudes is described by Professor R. S. Tarr. The abundant lichen flora, the air and water and the great variations of temperature are the active agents.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES, FEBRUARY 1, 1897.

SECTION OF ASTRONOMY AND PHYSICS.

THE first paper was one postponed from last month by H. Jacoby, 'On two Trailplates of Circumpolar Stars, made by Anders Donner at the Helsingfors Observatory.'

It was explained that these photographic negatives of circumpolar stars were taken with the telescope stationary, and hence that each star left a trail upon the plate, which, after necessary corrections, would be an arc of a circle around the true north pole of the heavens. The exposure, which was for a few moments at intervals of a half hour, extending over 14 hours, thus gave a series of short arcs extending over a little more than a semicircle. This method, if no unforeseen difficulties appear, should give the position of the pole to within a few hundredths of a second of arc and a system of right ascensions differing from the truth by a uniform correction.

The paper was discussed by R. S. Woodward and others.

Mr. P. H. Dudley then presented a paper under the following title: 'Investigations of Undulations in railway tracks by his track indicator, and the reduction of two-thirds of the amount in the last fifteen years, by the use of his stiff-rail sections.'

Mr. Dudley pointed out the causes and character of the inequalities in railroad rails, and described his very perfect car for obtaining a complete record of the condition of the track while travelling at 20 to 25 miles per hour. Among other records given is the summation of the inequalities of the rail per mile. A dozen years ago this total unevenness amounted to six or seven feet even on the better roads; now as a result of the records of the car, and of new designs and methods of manufacture of rails, the total has been reduced to 18 to 20 inches. It was shown that this remnant was due to dents in the rails and could not be helped by work on the road bed, but must be reduced by further improvements in the manufacture of the rails.

Sections of rails and indicator records were exhibited, and lantern slides shown to illustrate the above improvements on the New York Central and Boston and Albany system. A great proportion of the gain is due to the improvement in Mr. Dudley's improved rail sections, which give a maximum of rigidity and wear, with a minimum of weight.

R. S. Woodward pointed out the extreme importance of many of the problems upon which Mr. Dudley is working, and hoped that the author's idea of a rail-rolling machine, which would turn out a 60-ft. rail *straight* and *cold*, would soon be put into operation. W. Hallock remarked upon the advantages to science which were sure to come from the author's investigation of many physical questions which cannot be studied in a laboratory and need a railroad to experiment with.

J. J. Stevenson called attention to what the community at large owes to Mr. Dudley's improvements. It means heavier engines, heavier cars, longer trains, greater speed, reduced freight and passenger rates, all of which greatly contribute to the general welfare and the advance of civilization.

H. S. Curtis presented a paper on 'The advantages of long-focus Lenses in Landscape Photography.' After referring to the unsatisfactory results of photographing landscapes with ordinary lenses, owing to false perspective and lack of detail, he showed how this was remedied by lenses of longer focus. A telescopic

combination of 40-inch focal length was used by reversing the lens and putting the flint and crown about 1 mm. apart. A number of views were shown to illustrate the advantages of such lenses.

Several pictures were taken with an ordinary spectacle lens, 34-inch focus, stopped to about ⅛-inch diameter, which were very good indeed and scarcely distinguishable from those taken with the telescopic lens or a telephotic combination. Such a lens can be bought for ten cents.

J. F. Kemp spoke of the comparative uselessness of ordinary photographs in the study of mountain geology, and believed that such a simple camera would be of great value in field work. The paper was discussed by others.

Wm. Hallock,
Secretary of Section.

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY, FEBRUARY 15, 1897.

The first paper of the evening was by Mr. F. C. Nicholas, and was entitled 'Explorations in in the Gold Fields of Western Colombia.' Mr. Nicholas described the curious placers in western Colombia, which, while extremely rich in limited portions, are of very low grade when considered as extended propositions. The gold gravels occur along the western base of the Andes Mountains, and extend from the Gulf of Darien southward, up the Atrato River, to Quibdo. They are also found to the southward of the San Juan River and are in the form of terraces similar to the terraces of the Atlantic States. After the formation of the auriferous gravels the speaker supported the view that igneous intrusions and upheavels had cut them off from their parent hills in the interior and had recognized the drainage, so that the streams do not now head in auriferous rocks. The surface geology indicated that the Gulf of Darien formerly extended a long distance up the valley of the Atrato. Quite detailed descriptions of the gravels and of the character of the terraces were given in the paper. Mr. Nicholas described a route by which a man could sail in a canoe from the Atlantic to the Pacific in the wet season by going up the Atrato River to the Quito River, thence to the divide, which is in a series of swamps, thence into the San Pablo River and on down the San Juan to the Pacific.

The second paper of the evening was by Professor R. E. Dodge, entitled 'Recent Work in Physiography.'

Professor Dodge gave an outline of De Lapparent's 'Leçons en Geographie Physique,' of Sir John Lubbock's 'Scenery of Switzerland,' and of two recent papers, one by M. R. Campbell, entitled 'Drainage Modifications and their Interpretation,' and the other by C. F. Marbutt, 'On the Physical Features of Missouri.'

The last paper of the evening was by A. A. Julien, on the 'Sculpture and Sorting of Sands.' The speaker, by means of lantern slides, illustrated various varieties of sand and their chief methods of origin and their composition. After citing the schemes for the classification of sands advanced by Zirkel and Daubrée he gave one of his own which was more elaborate and was partly based on the method of origin and partly on the physical characters.

J. F. Kemp,
Secretary.

AMERICAN CHEMICAL SOCIETY—NEW YORK SECTION.

The meeting was held at the College of the City of New York on Friday, February 5th, at 8:30 p. m., Dr. Wm. McMurtrie presiding, and about fifty members present.

The first hour was occupied with the 'Discussion of the Relations of the Section with the Scientific Alliance.'

Professor Breneman opened the discussion. Dr. Wiley described the work done by the Affiliated Societies of Washington, the advantages resulting from cooperation and more which might result from a little additional effort. He stated that, with possibly one exception, the Washington Societies were all strictly professional.

Professors Sabin, Doremus and others spoke strongly in favor of the Alliance; others thought the promised advantages had not materialized and that the returns were not proportionate to the annual subscription.

Dr. H. W. Wiley read a paper on the 'Value of Foods and the Methods of Ascertaining it,'

pointing out the disparity, at least until very recently, in the relative amounts of investigation and interest bestowed upon 'man foods' and animal foods. He described the classes of foods rated according to their fuel values, digestibility, etc., and noted the divergence between price and actual food value of many articles, some of them not luxuries.

The papers announced on 'Volumetric Estimation of Lead,' by J. H. Wainwright, and 'Electrolytic Production of Alkali Nitrites,' by Wm. M. Grosvenor, were held over until next meeting.

DURAND WOODMAN,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON, 58TH MEETING, JANUARY 9, 1897.

MR. WHITMAN CROSS read a paper on 'The igneous rocks of the Leucite Hills and Pilot Butte, Wyo.,' in which he stated that the rocks of the Leucite Hills occur as surface flows and in volcanic necks or plugs. The leucite rock described by Zirkel, 20 years ago, is the least abundant type in the region, the other varieties containing more or less potash feldspar, as pointed out by Kemp in his recent communication to the Geological Society of America. Chemical analyses of various rock types were submitted, together with analyses of the pyroxene and mica.

The rock of Pilot Butte, an isolated point near the Leucite Hills, was also described and its chemical composition shown by an analysis. This rock is closely related to the leucite rocks, although containing much glass.

In a large cavity of the leucite rock was found a quantity of potash nitre, and on a protected face of the Boar's Tusk, a volcanic plug, was observed a white coating of soda nitre. The origin of these nitrates, whose mode of occurrence is so unusual, is not explained by any observations made.

This communication will soon be published in some scientific serial.

Mr. W. Lindgren read a paper on 'The Granitic Rocks of the Sierra Nevada,' in which he called attention to the large areas of intrusive granitic rocks occurring along the Pacific coast and to the fact that these intrusives are of comparatively recent date, probably early Cretaceous. A map of the distribution of the various kinds of granitic rocks in the northern part of the Sierra Nevada was exhibited. It was shown that, while some true granite exists, the largest mass is made up of grano-diorite, a rock intermediate between granite and diorite or, more accurately, intermediate between a quartz-mica-diorite and a quartz-monzonite, recently defined by Brögger.

W. F. MORSELL.
U. S. GEOLOGICAL SURVEY.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held January 6th, eighty persons present.

Mr. A. W. Grabau read a paper on the sand-plains of Truro, Wellfleet and Eastham. (For an abstract see above p. 344.)

Professor N. S. Shaler, in commenting upon Mr. Grabau's paper, said that his observations agreed with those of Mr. Grabau as to the origin of the sand plains. The slopes are due to a complexity of causes and frequently cannot be discriminated. The hypothesis of fresh-water lakes and the ponding of streams was rejected as inadequate. Professor Shaler said that the agency of ants in the formation of these sand plains was very great, and should be considered in relation to any theory accounting for them.

Mr. J. B. Woodworth spoke of the difficulty of making out the internal structure of sand plains; he had observed that the gravels near the head were coarser than those from other parts. Mr. Woodworth compared the sand plains of the Cape region as described by Mr. Grabau with those he had studied in the Narragansett Bay district. The hypothesis of fresh-water lakes applies equally to the Narragansett Bay district. The kettle holes indicate masses of ice after the melting of the ice sheet.

Prof. W. M. Davis claimed that the slopes could be discriminated, but that they should not be solely relied upon.

Professor Shaler contended that the slope depended upon the material, and that the original angle is unreliable until the material is known. The difference of height of sea level should be

considered, and the origination of the deltas in the sea was advocated.

Mr. Grabau replied briefly to some of the points raised in the discussion and emphasized the differences between erosion slopes and construction slopes; the pointing of the slopes was stated; the material on the northern side of the sand plains was perhaps coarser.

Professor W. M. Davis defined briefly and with graphic illustrations coastal plains, and gave the outline for a geographic classification of the same. He advocated the use of distinctive descriptive names, and stated that the introduction of such terms as *doab* and *cuesta* would be of advantage to geographic science.

Professor Shaler claimed that many of the terms could be expressed by words in our own language, and that the introduction of words from foreign sources was to be deprecated.

Samuel Henshaw,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the evening of February 1, 1897, Professor L. H. Pammel read a paper embodying ecological notes on some Colorado plants, observing that botanists who have studied the Rocky Mountain flora have frequently commented on the interest attached to the plants from an ecological standpoint, but most perplexing to the systematist. It is not strange that this should be the case, since there are great differences in altitude and soil, and the relative humidity of the air varies greatly. This is a most prominent factor in the development of plant life. A cursory glance at the plains flora of eastern Colorado shows that there are representatives of a flora common from Texas to British America and east to Indiana. We should not for a moment suppose that the species are identical in structure, since the conditions under which they occur are so different. Attention was called to the great abundance of plants disseminated by the wind, as *Cycloloma*, *Salsola*, *Solanum rostratum*, *Populus*, *Cercocarpus*, 'Fire-weeds' (*Epilobium spicatum* and *Arnica cordifolia*), *Hordeum jubatum*, *Elymus sitanion*, etc. Plant migration may be studied to better advantage in the irrigated districts of the West than elsewhere, partly because the water carries many seeds and fruits in a mechanical way, and partly because the soil is very favorable for the development of plants. Instances were cited where several foreign weeds are becoming abundant, as *Tragopogon porrifolius* and *Lactuca Scariola*. The latter, known as an introduced plant for more than a quarter of a century, is common at an altitude of 7,500 feet in Clear Creek Cañon. Once having become acclimated, it is easy to see how Prickly Lettuce is widely disseminated.

Collectors appreciate the great importance of giving more attention to conditions under which plants thrive, such as phases of development, soil, climate and altitudinal distribution. Structures of plants are produced to meet certain conditions. Under extreme conditions protective devices are more pronounced. In discussing some of the plants, Warming's classification into Hydrophytes, Xerophytes, Halophytes and Mesophytes was adopted. The Mesophytes of eastern Iowa were compared with some of the Xerophytes of western Iowa, such as *Yucca angustifolia*, *Mentzelia ornata*, *Liatris punctata*, etc. These increase in abundance in western Nebraska, and attain a maximum development in northern Colorado. In the foot-hills and mountains the Mesophytes constitute a large class, although the Xerophytes are common in dry, open, sunny places. The photosynthetic system is reduced to guard against excéssive transpiration which would otherwise take place at high altitudes. The thick rootstock of alpine plants in dry open places is an admirable protection against drouth and cold. In cañons where snow remains on the ground plants do not need this protection. Halophytes are not numerous in species and genera. Hydrophytes are abundant at higher altitudes, where they occur in marshes and along streams.

At the meeting of the Academy of Science, of St. Louis, on the evening of February 15, 1897, Professor J. H. Kinealy presented a preliminary discussion of the Poley air-lift pump, a device for pumping water from artesian wells by injecting into the pump tube, at a considerable depth below the surface of the water, bubbles of air from an air compressor.

Mr. Trelease exhibited two hair balls removed from the stomach of a bull in Mexico, and showed that they were composed of the pointed barbed hairs of some species of prickly pear upon which the animal had unquestionably fed. Attention was called to similar balls from the stomachs of horses, which had been described in 1896 by Mr. Coville, of the United States Department of Agriculture.

WM. TRELEASE,
Recording Secretary.

THE TEXAS ACADEMY OF SCIENCE.

AT the regular meeting of the Texas Academy of Science, held in the chemical lecture room of the University of Texas, at Austin, on Friday, February 5, 1897, Lieutenant W. V. Judson, U. S. A., presented a paper on 'The Improvement of Galveston Harbor.'

This important communication, by one of the engineers in charge, dealt with the following topics: (1) Introduction, The Problem in the Case. (2) Physical Characteristics, etc. (3) Early Operations. (4) Project of 1880 and Work there under. (5) Project of 1886. (6) Operations 1886–1891. (7) Continuous Contract System. (8) Contract with O'Conner, Laing and Smoot. (9) Dredging. (10) Physical Results.

In stating the problem, the speaker, after defining natural harbors, briefly discussed 'bars,' which he grouped into the following classes: (1) Drift Bars on seaward side of passes into areas embayed by sandy islands and peninsulas. (2) Drift Bars at the mouths of rivers emptying into non-tidal seas. (3) Drift Bars emptying into tidal seas. (4) Sediment Bars at the mouths of delta-building rivers. The Galveston Bars were assigned to class 1. The principles governing harbor improvements were next stated. Under Physical Characteristics, Galveston Bay was described as an area of water, consisting of 490 square miles, bounded by the main land of Texas, Bolivar Peninsula and Galveston Island. Two passes connect it with the Gulf of Mexico: (1) San Louis, with a cross-section of 20,000 square feet; (2) The Principal Pass between Galveston Island and Bolivar Point. Width of the gorge, 8,200 feet; depth, 0–50 feet. For purposes of deep draught navigation the first is unimportant, consequently the improvements have been confined to the latter. To give an adequate idea of this work, it may be here stated that in 1867 there were 9½ feet of water on the inner bar of this pass and 11 feet on the outer. On January 1st, of the present year, there were 25 feet of water at low tide on both bars.

The first attempt to improve Galveston harbor began with the congressional appropriation of 1870. For ten or fifteen years thereafter work was intermittently carried on as Congress made appropriations. The present jetty system, which has opened Galveston as a deep-water port, was based on the 'Project of the Board of 1886,' which consisted of Generals J. C. Duane, Henry L. Abbot and Cyrus B. Comstock.

The following paragraph taken from Lieutenant Judson's paper will give the reader some conception of the magnitude of this, now virtually completed, undertaking: "To build the Galveston jetties there has been spent between July, 1887, and January 1, 1897, $6,029,283.84. There has been incorporated in the jetties 88,355 cars of clay and rock aggregating 17,544.31 cubic yards of clay and 1,800,672.90 tons of granite and sandstone. To use a popular form of illustration, if loaded on cars, the material placed in the jetties since 1886 would form a train reaching from New York City to Cleveland, Ohio, and if this material were piled uniformly over an acre of ground it would be 1,050 feet above its base. I can recall no other single instance of work constructed by the hand of man that embodies within itself such a mass of material transported such a distance." The haul for the sandstone was 130–206 miles; for the granite 294 miles.

Mr. T. U. Taylor, professor of engineering in the University; Mr. Charles Corner, Engineer of the Texas Railroad Commission; President Winston and others took part in the interesting discussion that followed.

FREDERIC W. SIMONDS.

THE GEOLOGICAL CLUB OF THE UNIVERSITY OF MINNESOTA.

AT the regular meeting on January 23d two topics were presented by Mr. Charles P. Berkey.

The first was an announcement of the oc

currence of native copper and other copper minerals in the hematite ore of the Montana Mine, Soudan, Minnesota. The copper occurs in a thin seam and, in smaller amount, in cavities of the fractured ore. The original mineral of the group is native copper. This has been altered extensively to cuprite, malachite and, in more limited quantity, azurite. These minerals are found penetrating the ore for a distance of five or six feet below the seam and horizontally for a distance of eighty feet. None of the secondary minerals occur above the native copper. All the minerals are exceptionally pure. Some specimens of the copper show former crystals, the faces of which are now heavily coated with secondary products.

Attention was called to the very unusual association of these minerals. So far as the writer is aware, no similar occurrence has been recorded from the iron mines of the United States.

The second topic included several charts illustrating the glacial geology in the vicinity of Taylor's Falls, Minnesota. At this place the line of separation between the so-called eastern and western drift is very sharply defined. The course of the St. Croix river seems to be determined by the mutual adjustments of the eastern and western ice lobes. The moraine made up of typical eastern drift forms a close border along the east bank of the river for several miles, while typical modified western drift borders the west bank and, in at least one point, crosses the river. The combined effect is to force the river over the southwestern extension of the copper-bearing diabase of Keweenawan age exposed in this vicinity. It was further shown that the eastern drift occurs both below and above the western, arguing a readvance of the eastern lobe of ice upon the area of the receding western sheet. It was also shown that partially stratified early drift occupies a position so far below the average elevation of the sandstone surface in the present river gorge that it seems to indicate the location of a pre-glacial stream course at this place. Glacial action simply deepened this course and made it more permanent by directing through it a great glacial river. It was further pointed out that the original topography of the country was such that any flow of ice from the north or northeast would concentrate exceptional eroding force in the gorge of the St. Croix in the vicinity of the present falls.

JANUARY 30TH, 1897.

AT this meeting Mr. George W. Becker reviewed some of the points in the geology of northern Georgia. Facts derived from personal observation upon a recent visit to that locality were discussed at some length. These related chiefly to the methods employed in gold mining, to the value and extent of the asbestos deposits of Yhona Mountain, and the occurrence of corundum in northern Georgia.

CHARLES P. BERKEY,
Secretary.

NEW BOOKS.

Zeit-und Streitfragen der Biologie. OSCAR HERTWIG. Jena, Gustav Fischer. 1897. Heft II. Pp. iv+277.

Beiträge zur Kenntnis der Septalnectarien. J. SCHELWIND THIES. Jena, Gustav Fischer. 1897. Pp. 87 with 12 plates. 15 M.

Beiträge zur Lehre von der Fortpflanzung der Gewächse. M. MÖBIUS. Jena, Gustav Fischer. 1897. Pp. viii+212. 4.50 M.

Kainogenesis als Ausdruck differenter phylogenetischer Energien. ERNST MEHNERT. Jena, Gustav Fischer. 1897. Pp. 165 with 3 plates.

Angewandte Elektrochemie. FRANZ PETERS. Vienna, A. Hartleben. 1897. Pp. 338. 3 M.

The Forcing Book. L. H. BAILEY. New York, The Macmillan Company. 1897. Pp. xiii+266. $1.00.

Analysis of the Sensations. ERNST MACH, translated by C. M. WILLIAMS. Chicago, Open Court Publishing Company. 1897. Pp. viii+208. $1.25.

Eclairage. J. LEFEVRE. Paris, Gauthier Villars et fils, Masson et cie. 1897. Pp. 180.

Les succédanés du chiffon en papeterie. Paris, Gauthier Villars et fils, Masson et cie. Pp. 173.

Glaciers of North America. I. C. RUSSELL. Boston, Ginn & Co. 1897. Pp. x+210.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, MARCH 5, 1897.

CONTENTS:

Goode Memorial Meeting: CYRUS ADLER.....365
George Brown Goode: S. P. LANGLEY.....369
Goode as a Naturalist: HENRY F. OSBORN.....373
The National University: CHARLES W. DABNEY, JR.378
The Coast and Geodetic Survey: J.....384
The American Morphological Society: G. H. PARKER.....388
Zoological Notes:—
The Florida Monster: A. E. VERRILL. *A New Subgeneric Name for the Water Hares (hydrolagus* GRAY): EDGAR A. MEARNS.....392
Current Notes on Anthropology:—
Woman in China; Death Masks in Europe and America; Ontario Archæological Report: D. G. BRINTON.....393
Notes on Inorganic Chemistry: J. L. H.....394
Scientific Notes and News:—
Vertebrates from the Kansas Permian: S. W. WILLISTON. *A New Botanical Laboratory in the American Tropics:* D. T. MACDOUGAL. *An Alloy composed of Two-thirds Aluminum and One-third Zinc; General*.....395
University and Educational News.....399
Discussion and Correspondence:—
An Ambitious 'Paradozer': S. NEWCOMB. *Former Extension of Greenland Glaciers:* T. C. CHAMBERLIN. *Two Extraordinary British Patents:* H. CARRINGTON BOLTON. *Compliment or Plagiarism:* ARTHUR LEFEVRE. *Reduced Rates of Postage on Specimens of Natural History in the International Mails—An Appeal:* H. A. PILSBRY, LEWIS WOOLMAN, PHILIP P. CALVERT. *The Lavoisier Monument:* EDGAR F. SMITH.....400
Scientific Literature:—
List of the Vertebrated Animals in the Garden of the Zoological Society of London: FRANK BAKER. *Hirsch on Genius and Degeneration:* CHARLES L. DANA.....404
Scientific Journals:—
American Journal of Science.....406
Societies and Academies:—
The Philosophical Society of Washington: BERNARD R. GREEN. *Science Club of the University of Wisconsin:* WM. S. MARSHALL.....408
New Books.....408

GOODE MEMORIAL MEETING.

ON Saturday evening, February 13, 1897, a memorial meeting was held in the lecture room of the United States National Museum at Washington, to commemorate the life and services of the late George Brown Goode. Over four hundred persons were assembled, representing the seven scientific societies and the patriotic and historical societies of Washington, the American Philosophical Society and the American Society of Naturalists.

The meeting was presided over by the Honorable Gardiner G. Hubbard, President of the Joint Commission, who opened the exercises with some brief remarks. He explained that the day was chosen because it was Dr. Goode's natal day, he having been born on the 13th of February, 1851. "Never," said Mr. Hubbard, "was there a truer, a more intelligent counsellor, a more sympathetic friend, a more ready helper, a more kindly nature."

> "None know him but to love him,
> None named him but to praise."

"His mind was versatile, his interests widespread, his tastes refined, his judgment correct. He was a true lover of nature, of art, of beauty everywhere." "Into the work of the Museum he threw his heart and life." "He was urged last summer to go to the Seal Islands, but he was reluctant to leave his work. He re-

mained to die at his post." "He was a friend whom I loved and whom I miss from my daily life."

Dr. S. P. Langley, Secretary of the Smithsonian Institution, then delivered an address in which he spoke of Dr. Goode's moral qualities, his success as an administrator, his love of nature and of men, his fine literary and æsthetic instincts. The address is given in full in this number of SCIENCE.

He was followed by Postmaster-General Wm. L. Wilson, the subject of whose address was 'Goode as a Historian and Citizen.' In the course of his remarks Mr. Wilson said:

"It has been most appropriately assigned to those who were privileged to see more of Doctor Goode than myself, in his domestic life and in daily official intercourse, to speak of his virtues and his most charming and lofty traits as a man; and to speak of him in his chosen field of science, must be assigned to those who do not, like myself, stand outside of the pale of scientific attainment. The somewhat humbler part is mine, to speak of Doctor Goode in those relations in life in which he was probably less known and less thought of than as a man of science, or in other fields of his distinguished attainment.

"Doctor Goode was honored in his own country, and in other countries, as an eminent man of science, and deservedly so honored; and his lasting fame must rest upon his solid and substantial contributions to science and the advancement of human knowledge; upon his eminent success as an administrator of scientific organizations, and in that work which all his life shows to have been most congenial to him—the bringing of science down to the interest and instruction of the common people.

"He was a richly endowed man: first, with that capacity and that resistless bent toward the work in which he attained his his great distinction, that made it a perennial delight to him; but he was scarcely less richly endowed in his more unpretending and large human sympathies, and it was this latter endowment that distinguished him as a citizen and as a historian.

"As a citizen he was full of patriotic, American enthusiasm. He understood, as all must understand who look with seriousness upon the great problems that confront a free people and who measure the difficulties of those problems—he understood that at least one preparation for the discharge of the duties of American citizenship was the general education of the people; and so he advocated, as far as possible, bringing down to the reach of all the people, not only the opportunities, but the attractions and the incitements to intellectual living.

"Doctor Goode, with the quick and warm sympathies of the man and of the historian, seems to have felt that he could do no greater service to the people of his day and generation and to his country, than in the most attractive and concrete way, if I may so express it, to lead the young men of this country to a study of the history of the past—to the deeds and the writings of the great men to whom we owe the foundation and the perpetuation of our institutions.

"Perhaps no family in this country has had so perfect a book, so complete a study of all its branches as Doctor Goode gave to the family whose name he bore, in that book entitled 'Virginia Cousins.' And it is especially gratifying to me to know that Virginia history, so much neglected, was perhaps the favorite field of Doctor Goode's study and investigation. He was a student of the writings of Washington and gathered all the materials he could find about that great Virginian. He was a student of the writings of Jefferson; he was a student of the lives of other distinguished men of that old Commonwealth, and I am told that he had in contemplation the publication of

a book to be called 'Virginia Worthies,' in which doubtless he would try to give the proper standing to that minor and second class of Virginia great men of whom the country at large knows so much less to-day than it ought to know.

"But Dr. Goode was not only an historian in this respect and in this peculiar way. He was also an historian of science, and he seems here likewise to have followed the same general idea of grouping scientific history—the history of scientific progress—around the particular man and individuals connected with that progress.

"I am told that in certain lectures, partly published and partly as yet unpublished, he has given us the most interesting and instructive history yet produced of the progress of science in the United States; so that it is not attributing to Dr. Goode a novel and undeserved character to speak of him as an historian. Had his life been spared, in his peculiar way, in his own personal and attractive manner, he would doubtless have made most substantial contributions to the study of American history; and I cannot doubt, as I have already said, that in doing this he was impelled by the patriotic idea that he was helping to build up a strong, American, intelligent citizenship in the country he loved so well."

Pofessor Henry F. Osborn then spoke of 'Goode as a Naturalist,' reviewing his numerous contributions to the study of natural history and touching upon his fine character, his distinguished position as a museum administrator, and the elements which made him a leader of men and a controlling power in the natural history and museum work of the country. Professor Osborn's address appears in full in this issue of SCIENCE.

The final address was by Professor William H. Dall, of the United States National Museum, on 'Goode's Activities in Relation to American Science.' Professor Dall traced the origin of government scientific institutions. These he showed were not 'created' by Congressional fiat, but were due in reality to the unselfish devotion of master minds. "A great institution," he said, "is not created; it is built up. With the mortar of its foundations is mixed the blood and sweat of its builders. Something of the very soul of its architect springs with its pinnacles towards the heavens." He then described the multitudinous operation of the Museum; its cooperation with museums and institutions of learning in this and other lands and the wide knowledge, infinite tact and unwearying devotion which Dr. Goode displayed in directing all of these operations and relations to a useful end. "What has been said," remarked Professor Dall in conclusion, "I trust, is enough to show that no ordinary man could have done this work (and much else), and yet have left behind him no antagonisms, no memories of failure, no hint of insufficiency associated with his name. He is remembered as one never weary of well doing; who reached the heights, though ever aiming higher; whose example stimulated and whose history will prove a lasting inspiration."

Professor Dall then read from among a large number of letters received since the death of Mr. Goode, appreciating his great service and offering consolation, the following extracts:

Professor Henry Giglioli, of Florence, in writing to Mr. True, October 3, 1896, spoke of Mr. Goode as one of the men he loved and esteemed most. "I feel so crushed," he says, "by this terrible blow that I hardly know what I am writing;" "he was so full of energy and work, it is hard to believe that he is now no more. To you all at the National Museum the loss must be immense, but to many abroad it is a great and much felt sorrow. To Science in America, not alone, but in the civilized world, his loss is indeed irreparable and will be felt for years."

M. Henry de Varigny, of Paris, writes to Secretary Langley: "I have received the card which notifies me of the sad news of the death of that excellent and most distinguished man, G. Brown Goode. I was already acquainted with the fact, and had published a few lines of obituary notice in the *Revue Scientifique*, but I have not adequately expressed the feeling of true sorrow I experience when I remember that he is no more, and that his untiring activity and energetic kindness have ceased to be. He was very kind and obliging to me, and I shall keep a warm remembrance of him. Your loss is a great one."

William Wirt Henry, descendant of Patrick Henry, wrote to Mr. Hubbard: "It is a source of great satisfaction to me that I knew Dr. Goode personally and was privileged to be united with him in his work for the patriotic and historical societies with which he was connected. No one could know him without being impressed with his learning and modesty and with the sterling qualities of the man. I feel that his death is a loss which will be felt in every path in which he walked, and will be mourned by every votary of science."

The Hon. John Boyd Thatcher, Mayor of Albany, N. Y., wrote to Mr. Hubbard: "My personal knowledge of Professor Brown Goode began in 1890, when he gave his advice and counsel to the World's Columbian Commission in classifying the various objects into proper departments for exhibition, and more particularly in advising and establishing an adequate method of passing judgment upon the exhibits. In these matters I can testify to his ability and consummate skill. It was purely voluntary service he rendered, and I at once formed, and have still maintained, a profound sense of his goodness to those who were officially charged with work for which he knew we were most imperfectly equipped and to whom he gave not only suggestions, but detailed and elaborate and finished plans. It is the glory of the modern scientist and scholar that he subordinates himself to the accomplishment of public work. Our friend never asked to be identified personally with the accomplished thing. It was enough for him to know that some good was done and not that the world should know that it was done by him. The utter absence of selfishness in any life is worthy of recording in brass or in marble or in formulated words."

Doctor Möbius, of Berlin, writes January 26, 1897: "The unexpected death of Mr. George Brown Goode has deeply affected me. We were in agreeable communication to the advantage of our Museums. We have lost in him a distinguished promoter of our scientific efforts."

Dr. Richard Schöne, Director-General of the Royal Museums at Berlin, expresses 'his sincere regret at the death of this worthy scholar' and extends his sympathy.

Prof. Pavesi, Director of the Zoological Museum of the University of Pavia, offers his condolence. A similar message was received for the Museum Francisco-Carolinum in Linz.

Dr. Leon Vaillant, professor of the Museum of Natural History at Paris, says that "the ichthyological world has experienced a great loss."

Dr. H. von Ihering of San Paulo, Brasil, speaks of the loss the National Museum suffered both in administrative and scientific interests.

Dr. Duges, of Guanajuato, Mexico, expresses his profound regrets.

General O. B. Wilcox, U. S. A., representing the Sons of the American Revolution of the District of Columbia, then offered the following resolutions which were seconded by Rear-Admiral J. A. Greer, U. S. N., representing the Sons of the Revolution, and adopted by a rising vote:

We, the associates and friends of the late George Brown Goode, in the Scientific, Patriotic and Histor-

ical Societies of the City of Washington, being met together to commemorate his life and service, do recognize:

That in his death the world has lost a great man of true moral worth, unusual breadth of intellect, profound human sympathy, unswerving loyality to his duty and devotion to his family and his friends.

That America has been deprived of a most patriotic, public spirited and loyal citizen; American Science of its first Historian, and American History of an original investigator.

That Universal Science has lost one of its foremost Ichthyologists and a man broadly learned in the entire field of Natural History.

That the Scientific service of the United States government, the Societies to which he belonged, and all the institutions in America for the promotion of knowledge, have lost in him an ever faithful and willing cooperator.

Resolved, That this minute be communicated to the societies of which Dr. Goode was a member and a copy be sent to his family, to whom the persons here assembled extend their sincere sympathy.

It is expected that all of these addresses, together with a narrative of Doctor Goode's life, an account of his contributions to museum administration, a bibliography of his writings, and possibly a chapter on his work in National and International expositions will be fittingly published in a memorial volume, and it is also likely that a permanent memorial will be established.

But there is a memory in the hearts of all who knew him which grows more fond as the days pass by, mingled with a sense of grief and loss, not as yet tempered by the months that have elapsed since that sorrowful day in September on which Dr. Goode went to his reward.

CYRUS ADLER.

WASHINGTON, February 22, 1897.

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*GEORGE BROWN GOODE**

WHILE I am aware that it is only fitting that I should say something here about one I knew so well as the late Doctor Goode, I feel the occasion a trying one, for he was so dear a friend that my very nearness and sense of a special bereavement must be a sufficient excuse for asking your indulgence, since I cannot speak of him even yet without pain, and I must say but little.

Here are some who knew him still longer than I, and many who can estimate him more justly in all his scientific work, and to those who can perform this task so much better, I leave it. I will only try to speak, however briefly, from a personal point of view, and chiefly of those moral qualities in which our friendship grew, and of some things apart from his scientific life which this near friendship showed me.

As I first remember him it seems to me, looking back in the light of more recent knowledge, that it was these moral qualities which I first appreciated, and if there was one which more than another formed the basis of his character it was sincerity—a sincerity which was the ground of a trust and confidence such as could be instinctively given even from the first, only to an absolutely loyal and truthful nature. In him duplicity of motive even seemed hardly possible, for, though he was in a good sense worldly wise, he walked by a single inner light, and this made his road clear even when he was going over obscure ways, and made him often a safer guide than such wisdom alone would have done. He was, I repeat, a man whom you first trusted instinctively, but also in whom every added knowledge explained and justified this confidence.

This sincerity, which pervaded the whole character, was united with an unselfishness so deep-seated that it was not conscious of itself, and was, perhaps, not always recognized by others. It is a subject of regret to me, now it is too late, that I seem myself to have thus taken it too much as a matter of course in the past, at times like one I remember, when, as I afterwards learned,

* Address at the Goode Memorial Meeting held February 13, 1897, by Secretary Langley, of the Smithsonian Institution.

he was suffering from wretched health, which he concealed so successfully while devoting himself to my help, that I had no suspicion till long after of the effort this must have cost him. He lived not for himself, but for others and for his work. There was no occasion when he could not find time for any call to aid, and the Museum was something to which he was willing to give of his own slender means.

Connected with this was an absence of any wish to personally dominate others or to force his own personal ways upon them. It is pleasantest to live our own life if we can, and with him every associate and subordinate had a moral liberty that is not always enjoyed, for apart from his official duties he obtruded himself upon no one with advice, and his private opinion was to be sought, not proffered.

His insight into character was notable, and it was perhaps due as much as anything to a power of sympathy that produced a gentleness in his private judgment of others which reminded one of the saying that if we could comprehend everything we could pardon everything. He comprehended and he pardoned.

Associate this tolerance of those weaknesses in others, even which he did not share, with the confidence he inspired and with this clear insight, and we have some idea of the moral qualities which tempered the authority he exercised in his administrative work, and which were the underlying causes of his administrative excellence. I do not know whether a power of reading character is more intuitive or acquired; at any rate without it men may be governed, but not in harmony, and must be driven rather than led. Dr. Goode was in this sense a leader quite apart from his scientific competence. Every member of the force he controlled, not only among his scientific associates, but down to the humblest employees of the Museum, was an individual to him, with traits of character which were his own and not another's, and which were recognized in all dealings, and in this I think he was peculiar, for I have known no man who seemed to possess this sympathetic insight in such a degree; and certainly it was one of the sources of his strength.

I shall have given, however, a wrong idea of him if I leave any one under the impression that this sympathy led to weakness of rule. He knew how to say 'no,' and said it as often as any other, and would reprehend where occasion called, in terms the plainest and most uncompromising a man could use, speaking so when he thought it necessary, even to those whose association was voluntary, but who somehow were not alienated, as they would have been by such censure from another. "He often refused me what I most wanted," said one off his staff to me; "but I never went to sleep without having in my own mind forgiven him."

I have spoken of some of the moral qualities which made all rely upon him, and which were the foundation of his ability to deal with men. To them was joined that scientific knowledge without which he could not have been a Museum administrator, but even with this knowledge he could not have been what he was, except from the fact that he loved the Museum, and its administration, above every other pursuit, even, I think, above his own special branch of biological science. He was perhaps a man of the widest interests I have ever known, so that whatever he was speaking of at any moment seemed to be the thing he knew best. It was often hard to say, then, what love predominated, but I think that he had, on the whole, no pleasure greater than that in his Museum administration, and that, apart from his family interests and joys, this was the deepest love of all. He refused advantageous offers to leave it,

though I ought to gratefully add that here his knowledge of my reliance upon him and his unselfish desire to aid me were also among his determining motives in remaining. They were natural ones in such a man.

What were the results of this devotion may be comprehensively seen in the statement that in the year in which he was first enrolled among the officers of the Museum the entries of collections numbered less than two hundred thousand, and the staff, including honorary collaborators and all subordinates, thirteen persons, and by comparing these early conditions with what they became under his subsequent management.

Professor Baird at the first was an active manager, but from the time that he became Secretary of the Institution he devolved more and more of the Museum duties on Dr. Goode, who for nine years preceding his death was in practically entire charge of it. It is strictly within the truth then to say that the changes which have taken place in the Museum in that time are more his work than any other man's, and when we find that the number of persons employed has grown from thirteen to over two hundred, and the number of specimens from 200,000 to over 3,000,000, and consider that what the Museum now is, its scheme and arrangement, with almost all which make it distinctive, are chiefly Dr. Goode's, we have some of the evidence of his administrative capacity. He was fitted to rule and administer both men and things, and the Museum under his management was, as some one has called it, 'A House full of ideas and a nursery of living thought.'

Perhaps no one can be a 'naturalist' in the larger sense, without being directly a lover of Nature and of all natural sights and sounds. One of his family says, "he taught us all the forest trees, their fruits and flowers in season, and to know them when bare of leaves by their shapes; all the wayside shrubs and even the flowers of the weeds, all the wild birds and their notes, and the insects. His ideal of an old age was to have a little place of his own in a mild climate, surrounded by his books for rainy days, and friends who cared for plain living and high thinking, with a chance to help some one poorer than he." He was a loving and quick observer, and in these simple natural joys, his studies were his recreations, and were closely connected with his literary pursuits.

I have spoken of his varied interests and the singular fulness of his knowledge in fields apart from biologic research. He was a genealogist of professional completeness and exactitude, and a historian, and in these capacities alone a biography might be written; but his well-founded claim to be considered a literary man as well as a man of science, rests as much on the excellent English style, clear, direct, unpretentious, in which he has treated these subjects, as on his love of literature in general. I pass them, however, with this inadequate mention, from my incompetence to deal with him as a genealogist, and because his aspect as a historian will be presented by another; but while I could only partly follow him in his genealogical studies, we had together, among other common tastes, that love of general literature just spoken of, and I, who have been a widely discursive reader, have never met a mind in touch with more far-away and disconnected points than his, nor one of more breadth and variety of reading, outside of the range of its own specialty. This reading was also, however, associated with a love of everything which could illustrate his special science on this literary side. The extent of this illustration is well shown by the wealth and aptness of quotation in the chapter headings of his 'American Fishes,' his 'Game Fishes of North America' and the

like, and in his knowledge of everything thus remotely connected with his ichthyologic researches, from Saint Anthony's Sermon to Fishes, to the Literature of Fish Cookery, while in one of his earliest papers, written at nineteen, his fondness for Isaac Walton, and his familiarity with him are evident. He had a love for everything to do with books, such as specimens of printing and binding, and for etchings and engravings, and he was an omniverous reader, but he read to collect, and oftenest in connection with the enjoyment of his outdoor life and all natural things. One of these unpublished collections, 'The Music of Nature,' contains literally thousands of illustrated poems or passages from his favorite poets.

These were his recreations, and among these little excursions into literature, "the most pathetic, and yet in some respects the most consolatory," says his literary executor, "seems to have been suggested by an article on the literary advantages of weak health, for with this thought in mind he had collected from various sources accounts of literary work done in feeble health, which he brought together under the title 'Mens Sana in Corpore *Ins*ano.'"

Still another collection was of poems relating to music, of which he was an enthusiastic lover. He sang and played well, but this I only learned after his death, for it was characteristic of his utter absence of display that during our nine years' intimacy he never let me know that he had such accomplishments, though that he had a large acquaintance with musical instruments I was, of course, aware from the collections he had made.

We must think of him with added sympathy when we know that he lost the robust health he once enjoyed, at that early time during his first connection with the Museum, when he gave himself with such uncalculating devotion to his work as to overtask every energy and permanently impair his strength. It was only imperfectly restored when his excessive labors in connection with the Philadelphia Exposition brought on another attack, and this condition was renewed at times through my acquaintance with him. When we see what he has done we must remember, with now useless regret, under what conditions all this was accomplished.

I have scarcely alluded to his family life, for of his home we are not to speak here, further than to say that he was eminently a domestic man, finding the highest joys that life brought him with his family and children. Of those who hear me to-night most knew him personally, and will bear me witness, from his daily life, that he was a man one felt to be pure in heart as he was clean of speech, always sociable, always considerate of his associates, a most suggestive and helpful man; an eminently unselfish man—may I not now say that he was what we then did not recognize, in his simplicity, a *great* man?

"It is a proof," says one who knew him, "of the unconsciousness and unobtrusiveness which characterized Doctor Goode in all his associations and efforts that, until his death came, few, if any, even of his intimate friends, realized the degree to which he had become necessary to them. All acknowledged his ability, relied on his sincerity, knew how loyally he served every cause he undertook. The news of his death showed them for the first time what an element of strength he was in the work and ambitions of each of them; with a sudden shock they saw that their futures would have less of opportunity, less of enthusiasm and meaning, now that he was gone."

He has gone; and on the road where we are all going there has not preceded us a man who lived more for others, a truer man, a more loyal friend.

S. P. Langley.

*GOODE AS A NATURALIST.**

THE designation 'naturalist' was one which Goode richly earned and which he held most dear, and our deep sorrow is that his activity as a naturalist extended over only a quarter of a century. It is pleasant to reflect that he was a man of whom no adverse word can ever be spoken either in science or in character. We think of both at this time because in him the man and the profession were inseparable and constantly interacting. His scientific virtues were of an order rare as the Christian virtues, and we cannot thoroughly understand his scientific career unless we understand him as a man. Errors of judgment, misleading tenets and adherence to false hypotheses among some of the most gifted of our professional ancestors have arisen as often from defect of principle and from personal prejudices as from defect of knowledge. We see in our friend, on the other hand, that the high standard of scientific achievement was constantly parallel with, and very largely the outgrowth of, a high standard of personal character and motive.

In brief the work of the true naturalist is ever lighted by the four lamps of love, of truth, of breadth and of appreciation, and all of these shone brightly upon the path of Goode. His love of nature was inborn, predetermining his career, and so far surpassing his self-interest we fear it is only too true that he sacrificed his life for the diffusion of natural truth. So far as I know, he never entered a scientific controversy, and was never under temptation to warp or deflect facts to support an hypothesis, yet he was incapable of tampering with truth under any circumstances which might have arisen. His Presidential Address of 1887 before the Biological Society showed him as scrupulous not to overestimate as he was eager not to underestimate the existing status of American science. While largely cultivated by wide experience in contact with nature and men, his breadth of view was certainly innate. If Goode had a fault it was that his interests were too numerous and his sympathies too broad. He displayed not only a warm appreciation of those around him and an enthusiasm for contemporary research, but an exceptional sense of the close bonds between the present and the past, as seen in his admiration for the pioneers of American science, and his repeated vindication of their services. This passion for history led to an important phase of his literary work. His fine addresses, 'The Beginnings of Natural History in America' (1886), The Beginnings of American Science' (1888), 'The Literary Labors of Benjamin Franklin' (1890), and 'The Origin of the National Scientific and Educational Institutions of the United States' (1890). 'An Account of the Smithsonian Institution' (1895), sprang from the same instinct which prompted him to compile the valuable bibliographies of Baird, of Girard, of Lea and of Sclater, and to undertake the remarkable genealogy of his own family entitled 'Virginia Cousins.' The time, between 1887 and 1895, which he devoted to these subjects caused some of his fellow naturalists anxiety, yet I fancy this work was largely sought by him for diversion and rest, just as Michael Foster tells us that philosophy and controversy served as recreation to Huxley, at a time when overwork had given him a passing distaste for morphology.

His trend of life, guided by these four beacon lights, was swayed by two countercurrents—first, his strong impulses as an original investigator, and second, his convictions as to the duty of spreading the knowledge of nature. These currents moved him alternately. The most superficial view

* Address at the 'Goode Memorial Meeting,' National Museum, Washington, February 13th, by Henry Fairfield Osborn, DaCosta Professor of Zoology, Columbia University.

of his career shows that his whole environment fostered his public spirit and made difficult, and at times impossible, the retirement so essential to the studies of nature.

Goode's practical and public achievements for natural history, therefore, do him even more honor than his writings, because from June, 1870, when he graduated from Wesleyan University, to September, 1896, administrative service became paramount, and he was free to devote only the odd intervals of his time to research. Our great gain in the national institutions he has advanced is our corresponding loss in icthyology and the kindred branches of zoology.

Goode's successful work in the natural history courses at Wesleyan led at graduation to a position in the College Museum, where in 1870 he at once showed his great talent for systematic arrangement. In further preparation for zoology he went to Harvard and for a few months came under the genial influence of Louis Agassiz. But the turning point in his life came in 1872, when, working as a volunteer upon the United States Fish Commission at Eastport, he met Spencer F. Baird. The kind of simple but irresistible force which Abraham Lincoln exerted among statesmen, Baird seems to have exerted among naturalists. He at once noted young Goode's fine qualities, adopted him and rapidly came to be the master spirit in his scientific life. Goode delighted to work with a man so full of all that constitutes true greatness. He frequently spoke of Baird as his master, and intimate friends say that he never showed quite the same buoyant spirit after Baird's death—he felt the loss so keenly. Baird took Goode to Washington in the winter of 1872, and practically determined his career, for he promoted him rapidly through every grade of the Fish Commission and Museum service. It is hard to realize now the intensely rapid and eager development of our national scientific institutions in those years.

No doubt Baird's mantle fell fittingly upon Goode's shoulders, and he had all but the magnificent physique of his master to qualify him for this heavy burden. His talents and methods were of a different order. Both men enjoyed universal admiration, respect and even love, but Baird drove men before him with quiet force, while Goode drew men after him. Lacking the self-confidence of Baird, Goode was rather persuasive than insistent. His success of administration also came partly from an instinctive knowledge of human nature and his large faculty of putting himself in other men's shoes. He sought out the often-latent best qualities of the men around him and developed them. When things were out of joint and did not move his way he waited with infinite patience for the slow operation of time and common sense to set them right. He was singularly considerate of opinion. Not "I think," but "Don't you think?" was his way of entering a discussion. I am reminded of the gentleness of my teacher, Francis Balfour, when one of his students carelessly destroyed a rare and valuable preparation, as I learn from one of Goode's associates that, under similar provocation, without a word of reproof, he stooped over to repair the damage himself. He was fertile of original ideas and suggestions, full of invention and of new expedients, studying the best models at home and abroad, but never bound by any traditions of system or of classification. He showed these qualities in a marked degree in the remarkable Fisheries Exhibit which he conceived and executed for Berlin in 1879, and continued to show them in his rapid development of the scope as well as the detail of a great museum. To all his work also he brought a refined artistic taste, shown in his methods of printing and labeling, as well as in his encouragement of the

artistic, and therefore the truthful and realistic, development of taxidermy in the arrangement of natural groups of animals. To crown all, like Baird, he entered into the largest conception of the wide-reaching responsibilities of his position under the government, fully realizing that he was not at the head of a university or of a metropolitan museum, but of the museum of a great nation. Every reasonable request from another institution met a prompt response. I well recall Goode's last visit to the American Museum, the hearty approval of the work there, and especially his words: "I am glad to see these things being done so well in this country." Not the advancement of Washington science, but of American science, was his dominating idea.

In fact, every act and every word of Goode's breathed the scientific creed which he published in 1888:

"The greatest danger to science is, perhaps, the fact that all who have studied at all within the last quarter of a century have studied its rudiments and feel competent to employ its methods and its language, and to form judgments on the merits of current work. In the meantime the professional men of science, the scholars, and the investigators seem to me to be strangely indifferent to the question as to how the public at large is to be made familiar with the results of their labors. It may be that the use of the word naturalist is to become an anachronism, and that we are all destined to become, generically biologists, and specifically, morphologists, histologists, embryologists and physiologists.

"I can but believe, however, that it is the duty of every scientific scholar, however minute his specialty, to resist in himself, and in the professional circles which surround him, the tendency toward narrowing technicality in thought and sympathy, and above all in the education of non-professional students.

"I cannot resist the feeling that American men of science are, in a large degree, responsible if their fellow-citizens are not fully awake to the claims of scientific endeavor in their midst.

"I am not in sympathy with those who feel that their dignity is lowered when their investigations lead toward improvement in the physical condition of mankind, but I feel that the highest function of science is to minister to their mental and moral welfare. Here in the United States, more than in any other country, it is necessary that sound, accurate knowledge and a scientific manner of thought should exist among the people, and the man of science is becoming, more than ever, the natural custodian of the treasured knowledge of the world. To him, above all others, falls the duty of organizing and maintaining the institutions for the diffusion of knowledge, many of which have been spoken of in these addresses—the schools, the museums, the expositions, the societies, the periodicals. To him, more than to any other American, should be made familiar the words of President Washington in his farewell address to the American people:

"Promote, then, as an object of primary importance, institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinions, it should be enlightened."

As a naturalist Goode did not close any of the windows opening out into nature. His breadth of spirit in public affairs displayed itself equally in his methods of field and sea work and in the variety of his observations and writings. While fishes became his chief interest, he knew all the Eastern species of birds after identifying and arranging the collection in his College Museum. He loved plants, and in the latter years of his life took great pleasure in the culture of the old-fashioned garden plants around his house. He was not wedded to his desk, to dry bones nor to alcoholic jars. His sea studies and travels ranged, as early as 1872, from the Bermudas to Eastport, on the Bay of Fundy; to Casco Bay in 1873; to Noank, on Long Island Sound, in 1874. Here he conceived his great '*Index Bibliography of American Ichthyology*,' and here he met his future colleague, Bean, who describes him as 'a young man with plump cheeks and a small mustache.' During the following two years his Assistant Curatorship at the National Museum confined him, but in 1877 he was studying the fisheries off Halifax, and in 1879 off Provincetown. The work of the fishery census was starting up in earnest, and Goode was busy planning and getting together his men. Special agents were sent out to every part

of the coast and to the great lakes to gather information. Goode worked at it himself on Cape Cod, and manifested the same enthusiasm as in every other piece of work he took up. He interested himself in getting together a collection representing the methods of the fisheries and the habits of the fishermen. Neglecting neither the most trivial nor important objects, branching out into every collateral matter, he showed his grasp both of principles and of details.

His literary bent and facility of written expression showed itself before his graduation at Wesleyan in the *College Argus*, which contains seven brief papers, including his first scientific article, prophetically entitled 'Our Museum.' He contributed to the *American Naturalist* in 1871 a note upon 'The Bill-fish in Fresh Water,' and in 1872 'A Sea Bird Inland.' He published and presented before the American Association in 1873 his first paper of importance, entitled 'Do Snakes Swallow Their Young?' These studies of real merit foreshadow two marked features of his later work: First, his recognition of the importance of distribution, which culminated in the preparation of his unfinished memoir upon the '*Geographical Distribution of Deep-Sea Fishes*;' second, his close observation of the habits of animals, which was of marked usefulness in his subsequent Fish Commission service and treatises upon fish culture. His '*Catalogue of the Fishes of the Bermudas*,' from his 1872 visit, indicate how early in life he had thought out a thoroughly philosophical method of studying a local fauna. "In working up my notes," he says, "I have endeavored to supplement previous descriptions by (1) descriptions of the colors of the fishes *while living*, (2) notes on size and proportions, (3) observations on habits, (4) hints in reference to the origin and meaning of their popular names, (5) notes upon modes of capture and economic value. He increased the number of recorded species from 7 to 75 and gave a careful analysis of their probable geographical derivation.

Many of his briefer papers deal directly with the biological problems which attracted his interest, especially among reptiles and fishes, touching such questions as migration, coloring, albinism, mimicry, parasitism, feeding and breeding habits, the relation of forest protection to the protection of fishes.

It is difficult to classify the papers long and short which we find rapidly succeeding each other in the valuable bibliography prepared by Dr. Adler and Mr. Geare. Of his 193 independent papers, 21 are biological, 9 treat of reptiles and amphibians, 38 are devoted to the structure, life habits and distribution of the fishes, in addition to 15 purely systematic contributions upon the fishes. Among the former are his large Memiors upon the 'Menhaden,' his shorter treatises upon the Trunk Fishes, the Carangidæ, the Sword Fishes and the eel. The work of the Fish Commission is described and published at home and abroad in 30 reports and popular papers. The special branch of 'Fisheries Exhibits' is treated in 8 papers, and of fish culture in 12 papers. Besides his 14 reports as Director of the National Museum, he published, between 1881 and 1896, 13 papers developing the theory and practice of museum administration, leading up to his very notable articles, 'Museums of the Future,' 'Museum History and Museums of History' in 1889, and his invaluable memoir upon '*Museum Administration*' in 1895. His labors and writings placed him in the lead of museum experts in this country and upon the level of the distinguished leader of museum development in England, Sir William Flower. The closing sentence of his address before the English Museums Association must be quoted:

"The degree of civilization to which any nation, city or province has attained is best shown by the

character of its public museums and the liberality with which they are maintained."

His popular works include the 'Game Fishes in the United States,' published in 1879, a book written in charming literary style, besides innumerable short articles in the *Chautauquan*, *Forest and Stream* and SCIENCE. In 1888 appeared his 'American Fishes: a popular treatise upon the Game and Food Fishes of North America with special reference to habits and methods of capture.' These writings give us a further insight not only into the two sides of Goode's scientific nature, the theoretical and practical, but into his artistic and poetical sentiment and into the wide extent of his reading. Besides the long list enumerated above, he published 51 joint ichthyological papers with G. Brown, W. O. Atwater, R. E. Earll, A. Howard Clark, Joseph W. Collins, Newton P. Scudder, but his chief collaborateur was Tarleton H. Bean. Under their names appear 35 papers, but chief of all the 'Oceanic Ichthyology, a Treatise on the Deep-Sea and Pelagic Fishes of the World, based chiefly upon the collections made by the Steamers Blake, Albatross and Fish Hawk in the Northwestern Atlantic.'

In 1877 Goode saw his first deep-sea fish drawn fresh from the bottom and experienced a sensation which he thus describes in the preface of his monograph:

"The studies which have led to the writing of this book were begun in the summer of 1877, when the first deep-sea fishes were caught by American nets on the coast of North America. This took place in the Gulf of Maine, 44 miles east of Cape Ann, on the 19th of August, when from the side of the U. S. Fish Commission steamer 'Speedwell' the trawl net was cast into 160 fathoms of water. The writers were both standing by the mouth of the net when, as the seamen lifted the end of the bag, two strange forms fell out on the deck. A single glance was enough to tell us that they were new to our fauna, and probably unknown to science. They seemed like visitors from another world, and none of the strange forms which have since passed through our laboratory have brought half as much interest and enthusiasm. *Macrurus Bairdii* and *Lycodes Verrillii* are simply new species of well-known deep-dwelling genera, and have since been found to be very abundant on the continental slope, but they were among the first fruits of that great harvest in the field of oceanic ichthyology which we have had the pleasure to garner in the fifteen years which have passed since that happy and eventful morning. It seems incredible that American naturalists should not then have known that a few miles away there was a fauna as unlike that of our coast as could be found in the Indian Ocean or the seas of China."

In one of the latest of his 45 contributions to the Bulletin of the United States National Museum is the description of the discovery of the new deep-sea Chimæroid, for which, true to his appreciation of the past, he proposed the name *Harriotta* in memory of Thomas Harriott, the earliest English naturalist in America.

The quaint, old-fashioned style of some of Goode's essays again gives us an insight into his historic sense and his reversion to the ideas and principles of his Virginia ancestors. Seldom have we known the loyal, conservative spirit, of reverence for old institutions, fealty to independence of societies, combined with such a grandly progressive spirit in the cooperation of the government with the state, and of one country with an other, in the promotion of science.

Again, what impresses us most is Goode as the apostle of scientific knowledge, the conviction of his mission in life breathing through his earliest papers in the *College Argus* to his final appeal in SCIENCE for the 'Admission of American students to the French Universities.'

One of his intimate friends writes: "Sometimes we talked of more far-reaching matters and in such discussions I often took a position I had no faith in, hoping to draw him out. I remember once we fell to talking of the province of science, and for the sake of argument I took the position that most scientific work was merely a form of intellectual amusement and benefited no one. He became quite

earnest in his protest against that view and asserted his belief that the majority of scientific men were working toward the improvement of things and that it was the destiny of science to be the salvation of the world. At another time he unfolded the idea that man through science was approaching step by step nearer the Infinite Ruler of the Universe, and that it was only through these activities that he could hope to reach his proper destiny; that every amelioration in life, every improvement in manners, every change in theological tenets, was a token of man's unfolding through the working of intellectual forces.

Our lasting regret must be that Goode's life terminated just as he had richly earned the right to retire from the scientific service of his country, from your service and mine, my friends, to devote himself more exclusively to his own researches.

As early as 1880, during the herculean task of entering the New National Museum, Goode remarked to one of his friends: "We have had pretty hard scrambling; I think we will take a rest presently." But alas, the rest days never came. One duty after another fell heavily upon his too willing shoulders. All must have observed in later years a certain quiet melancholy which marked his overwork and conscious inability to cope with all that his ambitious and resourceful spirit prompted. None the less he showed a continuous and rapid intellectual development during the last ten years of his life, and it was evident that his powers were constantly expanding and that his brightest and most productive days were to come in his projected independent and joint researches. As before noted, his 'Geographical Distribution of Deep-Sea Fishes' was nearly completed, the charts having been exhibited before the Biological Society, and a mass of voluminous notes and valuable observations are ready to show that the distribution of deep-sea fishes is far from being general, as has been supposed, and that there are certain well defined thalassic faunal regions. Another projected work for which extensive materials were collected was upon the 'Fishes of America,' in which Dr. Theodore Gill was to have cooperated.

He was always encouraged by his supreme faith in the reward of honest intellectual labor, and it is pleasant to recall now that he took the keenest satisfaction in the completion and publication of the 'Oceanic Ichthyology,' which revived in him all his old natural history spirit. He regarded it as his chief life work, and once observed to his fellow-writer, Tarleton Bean, "it will be our monument," little foreseeing that in a fortnight he would be gone and that his friends and admirers all over the world would share this very thought in receiving the fine monograph a few weeks after his sudden and unexpected death.

Our friend has gone to his fathers. As a public spirited naturalist he leaves us the tender memory and the noble example which helps us and will help many coming men into the higher conception of duty in the service and promotion of the truth. We cannot forget his smile nor his arm passing through the arm of his friend. Thinking little of himself and highly of others, faithful to his duties and loyal to his friends, full of good cheer and helpfulness, it is hard for us to close up the ranks and march on without him.

Henry Fairfield Osborn.

THE NATIONAL UNIVERSITY.

A GROWTH, NOT A CREATION.

We Americans do not, as a rule, believe in 'the day of small things.' Whatever we do we like to do on a great scale and with a great rush and a great noise. Sometimes we are unwilling to do anything at all until we can do something very grand. Unquestionably, it is wise not

to try to do a thing until we are prepared to do it well; but our weakness is that, being a young and inexperienced people, whose growth has been rapid beyond precedent, we are not willing to wait for things to grow. We believe in making things outright by our might or buying them with our money. We do, indeed, possess magnificent powers of initiative, but we trust too much to those powers to accomplish our purposes, and oftentimes try to do things before the conditions are present and the times are ripe for them.

Our people believe in the power of the legislative fiat, and think they can accomplish anything by passing an act through Congress or a Legislature. Born legislators, every one of us, we think we can educate the people by law and make them good by law. 'Be it enacted' is our method of making all improvements and our remedy for all social ills.

A multi-millionaire who was considering the plans for a great university which he proposed to establish is said to have asked the distinguished president of an institution which he had just inspected by way of informing himself with regard to such matters, "Well, you have a big plant here; how much does it stand you in?" In like fashion, the ordinary American business man thinks, no doubt, that when we all decide that we want it we will appropriate a vast sum of money, erect a magnificent pile of buildings, and establish a board of regents made up of distinguished men, who, in turn, will organize a series of great faculties, and that these faculties will go to lecturing at once in beautiful halls to expectant crowds of young people, and there is the National University.

Every student knows that even with all this grand outfit we should still not have a true National University until we also have great scholars, thinkers and investigators to teach, and great laboratories and libraries in which they and their students can work. Congress can not create thinkers or build laboratories or collect libraries, even in a decade. Even with all these things present, there would still be lacking the university spirit and atmosphere, which are the results of development and the products of national culture.

We have not had a National University because we were not prepared for it. We were not competent to maintain or appreciate it. A National University is the richest fruit of the civilization of a people, and we shall see our great University opened when we are noble and cultured enough to build it. Washington foresaw clearly the necessity for such a university and provided for it as far as he could; but even he could not forsee that it would require a hundred years for the nation to take its primary, high school and collegiate training and so be prepared for the graduate course. If the times are now ripe for a National University, as many of us believe they are, it is because we have as a people completed our preparatory course, and are now ready to improve the opportunities afforded by such an institution. If the time has arrived to begin the work of its organization, it is partly because the scholars and thinkers are here, because many of the laboratories are already built, and our various National libraries are full of books; but, if we are ripe for the National University, it is chiefly because the spirit of study and research is beginning to stir our whole people. Because the real National University already exists in spirit, in the great scientific and historical establishments in Washington and throughout the country, the time has come to give it a body.

In an article in SCIENCE for January 15th the writer enumerated the scientific establishments of the government designed to develop the natural resources of the country, for the purpose of pointing out the ne

cessity for their better organization as a step towards the proper coordination of their work. It is proposed at this place:

First, to look at these and the other scientific bureaus of the government from the point of view of a National University, so as to see what we already have in Washington as basal material for such an institution and what will have to provide, in addition thereto, and

Second, to point out a method by which the Civil Service Commission can be used to promote the National University and assist the proper persons in securing its advantages and opportunities.

1. WHAT MATERIAL HAVE WE ALREADY IN WASHINGTON?

A good deal of work is going on in the Congressional Library and the libraries of the State and other departments, which corresponds to the literary work of a university, but there is little else in the government in Washington which would answer as a foundation for the departments of philology and philosophy of such an institution. These, however, are almost the only important departments which are not already represented here. Anthropology is represented by the Bureau of Ethnology and several other bureaus in the Smithsonian Institution and the National Museum. Political science and the science of society are represented by the several executive departments, by Congress and, more especially, in the work of the Congressional and other great libraries. Economics is pursued in many of its branches by all of these and especially by the Bureau of Statistics of the Treasury Department, the Department of Labor, and by the Census, which we hope is soon to be made a permanent thing. Jurisprudence and law are represented by the Supreme Court and the other Courts of the District; history by several bureaus in the State Department, the Smithsonian Institution and the Congressional Library; and education by the Bureau of Education, the office of Indian Affairs, the Department of Agriculture, etc. In these we have already, if not active teaching agencies, at least the very best facilities in these subjects to be found anywhere in this country, if not in the world.

It is in the department of science, however, that the government has the most and best basal material ready to hand upon which to build a National University. This department is weakest, perhaps, in some of the pure sciences. Mathematics, however, is ably represented by the National Observatory and the Nautical Almanac. Physics is illustrated extensively in the several bureaus of steam engineering, construction and ordnance of the Navy Department, and in the engineering and testing laboratories of the War Department. Almost every conceivable application of physics is studied in the Patent Office, and many of them also in the Coast Survey and the Weather Bureau. Engineering is also represented in the Coast and Geodetic Survey, the General Land Office, the various hydrographic offices and many other bureaus. Chemistry is practiced extensively in many laboratories, notably those of the Geological Survey and the Department of Agriculture.

In the Geological Survey and the National Museum we have the material for a department of geology, geography and paleontology, etc.; in the National Herbarium and the Division of Botany of the Department of Agriculture the material for a school of botany; in the Biological Survey, the Commission of Fish and Fisheries and the National Museum again, a complete collection of specimens and equipment is found for a department of general biology. And so through all the natural sciences. The men, the material and the laboratories are nearly all here already.

The material for the chief great profes-

sional departments is even more abundantly supplied. Medicine is magnificently represented in the office of the Surgeon-General of the Army, to which belongs the great army medical museum and library and many other useful offices. In the same connection are to be mentioned the Marine Hospital Service of the Treasury Department, with its admirable laboratories, the Bureau of Medicine and Surgery of the Navy, and the bacteriological and pathological laboratories of the Bureau of Animal Industry.

The material for the professional department of jurisprudence and law is, of course, unsurpassed. Law libraries are found in the Supreme Court, and in nearly all of the other Courts and in several of the executive departments. In fact, it would seem that everything is ready at hand for this department, save only the central organization and the lecture halls.

In the Department of Agriculture we find all the material ready to hand for a college of agriculture, horticulture and forestry; in the Bureau of Education are rich stores of statistics and other data for the use of students of pedagogics; in the office of the Architect of the Treasury there is the foundation for a school of architecture and construction. In fact, so much material is found in Washington that it will be difficult to decide what schools should be started first and and which postponed to some future time.

2. RELATION OF THE CIVIL SERVICE COMMISSION THERETO.

The relation of the Civil Service Commission to the National University has not received sufficient consideration. The danger from the spoils system has been the chief objection to the National University in the minds of some of our greatest and best men. Every one appreciates, therefore, the service which the Civil Service Commission has rendered the cause by reducing the opportunities for this vicious practice. The time has now arrived, however, when the Civil Service Commission can render this enterprise additional service by establishing a method through which properly prepared students can gain a support, corresponding to scholarships and fellowships, while prosecuting their studies in the different departments of the National University. It is to the method proposed for this purpose that the writer particularly desires to call the attention of the readers of SCIENCE at this time.

It is now proposed by the Civil Service Commission to establish a regular system of examinations to be held at stated times, convenient to the great educational centers in the country, once or twice each year, for the purpose of examining applicants for positions in the scientific service of the government. This general plan may be sufficiently indicated by describing the one already drawn up for the Department of Agriculture, which was the first to take it up.

All scientific assistants in this and other bureaus of the government, here referred to, have recently been brought into the classified service, as the clerical places had been before. To fill these positions it was necessary to arrange a systematic plan of examinations. Heretofore such of these places as were included in the classified service were filled by special examinations, held at irregular intervals, at the request of the Secretary of the Department. An examination was usually given for each particular position and an eligible list provided, from which one person was taken.

The objections to these special examinations are numerous. The notices given by the Civil Service Commission were necessarily short, and did not become widely known. The examination questions were hastily prepared to secure one eligible to fit a particular place, with the result that the person certified for the position had too

often only narrow special rather than broad scientific training. Too frequently the Department secured by this process only amateur scientists, having perhaps some ability and considerable knowledge in certain lines, but without general education and, therefore, limited in their usefulness and capacity to grow.

Another objection was that the list of eligibles provided in this manner was a temporary one only, being designed to get one person to fill one place. Under the rules of the Civil Service Commission such a list lived for one year only, and it was, therefore, rather unusual when a second person was taken from it. Such a system of examinations offers too little encouragement to candidates. Since special papers had to be prepared for each one of them and the examinations to be held in different parts of the country wherever there were applicants, the special examinations were troublesome and expensive to both the Civil Service Commission and the Department.

For their best work the scientific bureaus of the government need men of broader training than can be secured in this way. The ideal man, of course, for such a position is one who has had a liberal education, to which has been added general education in the natural sciences and special training and experience in some special department. In order to secure such a corps of experts it was necessary to establish these permanent lists of eligibles and keep them up by regular examinations, held at stated intervals.

After the new men are appointed in the department it is desirable to give them, before they are advanced to positions of responsibility, some preliminary training in the special work of the particular bureau. In the new plan it is provided, therefore, that these candidates shall come into the lower ranks first, where they shall have opportunities for advancement, if they prove worthy. The outlines of the plan proposed for the Department of Agriculture are given in an appendix to this paper.

It will be noticed that the examinations are not for specified positions, but for certificates of qualification in specified subjects or groups of subjects. Each candidate can form his own group of subjects to suit himself. The Civil Service Commission publishes lists of the various positions in the government scientific service and the general qualifications required for each. When a new assistant is required the Secretary names the qualifications he desires and the Commission certifies the three persons who have the highest grade in the subjects mentioned or come nearest to supplying all of the qualifications required.

It is hoped that the plan now adopted for the Department of Agriculture will, if it prove successful, be extended to include the other scientific bureaus of the government. All that will be necessary in order to do this will be to include other subjects in the examinations. When this has been done it is evident that the scientific service will have a much better list of eligibles from which to draw, and that the scientific students of the country will have, for the first time, a plain way opened up for their admission to these surveys and laboratories and to the enjoyment of the splendid opportunities which they offer.

From the standpoint of the scientific bureaus this plan has the advantage of supplying them with the highest class of assistants. Under it they would get persons educated for the work and capable of improving the advantages offered instead of persons having no special training and little or no ambition to improve themselves and advance human knowledge.

From the standpoint of the National University the government pay roll would be utilized to support a large body of properly educated scholars and fellows in the various

scientific faculties. With all our surveys, libraries and laboratories filled with such educated and devoted persons we should soon have in Washington a noble body of students.

It appears, therefore, that we need to take only two or three steps before we will have the National University for which we have waited so long. The first step, of course, will be to organize properly the scientific bureaus of the government as proposed in my former paper. The next step should be to extend the plan for civil service examination now arranged for the Department of Agriculture, to include all the bureaus of the government, and thus provide scholarships and fellowships for a much greater number of graduate students. When this is done, the only other thing necessary will be the central organization, with its deans and registrars, the boards of examiners to bestow degrees, and, finally, the outfit of buildings for lecture rooms and examination halls.

CHAS. W. DABNEY, JR.

APPENDIX.

PROPOSED PLAN FOR CIVIL SERVICE EXAMINATIONS FOR THE DEPARTMENT OF AGRICULTURE.

The object of this plan is to secure for the Department of Agriculture in all the grades of its service candidates having a broad general and scientific or technical training, and to encourage the graduates of scientific and technical schools of collegiate grade to enter the service of the Department in the lower grades with a view to making a career in its service or fitting themselves more fully for scientific and technical work in higher positions, either within or outside the government service. Considerable weight should, therefore, be given to the training which the candidate has received prior to his examination. It is proposed to establish a class to be designated "Assistant in the Department of Agriculture" with subclasses to correspond to the special subjects under A and B below.

I.—Character and Rating of Examinations.

Examinations for Assistant in the Department of Agriculture shall consist of five parts, as stated below and credit shall be given on the following percentage scale:

1. Basis Examination:	
For the convenience of the Civil Service Commission and as a test of fitness for temporary service on the clerical staff, the regular first grade basis examination is used:	
Orthography	1.5
Arithmetic	2.5
Letter Writing	2.5
Penmanship	1.5
Copying	2
	10
2. A statement of candidate's general training and experience	5
A test of proficiency in English composition.	5
	10
3. Major examinations on special scientific or technical subject	50
4. Minor examinations on two required subjects	20
5. Minor examinations on additional electives.	10
Total	100

II.—List of Subjects on which Examinations will be Offered.

Division A:

Chemistry, analytical, agricultural and industrial.

Physics, especially as applied in meteorology and soil study.

Meteorology.

Physical geography of the United States.

Botany, systematic.

Vegetable physiology and pathology.

Bacteriology.

Forestry.

Ornithology and mammalogy.

Entomology, general and economic.

Physiology and nutrition of man.

Animal pathology.

Animal production and dairying.

Rural engineering.

Statistics, especially of agricultural resources and productions.

Division B:

Bookkeeping.

Stenography.

Typewriting.

Proof-reading and indexing.

Editing and abstracting.

Library work.

Division C:

Latin, French, German, Italian, Spanish, etc. — Translating and abstracting scientific articles in these languages.

Two classes of examinations will be provided in

each of the subjects in A and B—a major examination for specialists and a minor examination for those who take the subject as an adjunct to their specialty.

III.—Rules for Examinations.

Candidates must elect one of the subjects in Division A or B as their specialty or major, the examination in which shall count 50.

In addition to the major special subject, candidates *must* be examined on two minor subjects chosen by themselves from Divisions A, B and C, at least one of which must be from Division A and one from either B or C. Each of these subjects shall have a maximum value of 10.

Each candidate *may* take as many additional examinations from Division A, B or C as he chooses, but no one examination will count more than 5.

Each candidate shall submit a statement of his educational history and opportunities for scientific training and experience, which shall be accessible to the Secretary of Agriculture in selecting eligibles for special positions.

IV.—Eligible Lists.

A record will be kept for each person on the eligible list of all the subjects in which he has passed.

Eligible registers shall continue two years from the date of examination.

Eligibles shall be drawn from the lists thus established to fill all vacancies in the scientific and technical service of the Department of Agriculture. Inspectors, assistant inspectors, meat inspectors, stock examiners, microscopists and assistant microscopists in the Bureau of Animal Industry outside of Washington, and river, rainfall and other special observers in the Weather Bureau, are not considered within this class, and these positions are to be filled, as provided under VI.

V.—Appointments and Promotions.

Candidates on the lists thus established shall be eligible to appointment to any position in the Department of Agriculture below the grade of Assistant Chief, under regulations to be established by the Commission. Vacancies occurring in any grade in the Department shall, as far as practicable, be filled by promotion from lower grades on such tests of fitness as the head of the Department shall prescribe. When this is not practicable, the Secretary of Agriculture shall call upon the Civil Service Commission to make certification from the aforesaid list of eligibles in accordance with the statement which he shall make regarding the duties of the position to be filled and the relative importance of these duties. It is expected that the positions of Assistant Chief and Chief will ordinarily be filled by promotion, but in case this is not practicable special examinations shall be held in which the employees of the Department shall be allowed to compete.

VI.—Temporary Service in Minor Positions.

Each candidate shall, at the time of examination, state whether or not he is willing to accept temporarily a position in the service of the Department outside the class of 'Assistant' here provided for, and, if so, what branch or branches of work he prefers. A record of this shall be kept in connection with the eligible lists of the branches thus selected, and whenever the Department of Agriculture shall ask for a veterinary inspector, microscopist, clerk-copyist, bookkeeper, stenographer, compiler, artist, curator, propagator, skilled laborer, or other class of eligible outside the class of 'Assistant' here provided for, the Civil Service Commission shall give the person who has passed the Assistant's examination (if there be one) preference in the certification. In case of failure to to find such scientific eligible, these positions shall be filled, as heretofore, from the list of eligibles for the general departmental service.

THE COAST AND GEODETIC SURVEY.

In consideration of the changes that will follow the appointment of a new Secretary of the Treasury, it is to be hoped that a searching investigation will be made into the policy which has resulted in such great injury to the Coast and Geodetic Survey.

This Bureau, organized at the instance of President Jefferson, has occupied a position in the esteem of men of science and affairs, at home and abroad, which has amply justified the wisdom of its projector—a result, in no small measure, due to the wise appreciation of the administrations which from 1807 to 1885 recognized the folly of subjecting to political vicissitudes the management of a service whose success depended upon the labors of a trained body of men, valued for their acquirements as hydrographers, topographers, astronomers and physicists, and dependent for their employment upon their merits and devotion to duty. During these years the Survey, either by discovery or improvement, has won many a laurel for American science, and no other body under the government has done more to make

the American name an honored one where applied science is recognized and appreciated. The physical hydrographic studies, applied in the improvement of our greatest harbors and in assisting the Mississippi Commissioners; the magnetic data it has collected, deduced and accumulated for the Surveyor, almost his only guide in settling disputes about land lines which now put in jeopardy millions of dollars worth of property; the admirable maps of the coast and adjacent waters it has produced, and the wealth of information its archives contain for the naval and military men upon whom may devolve the duty of protecting the country from foreign invasion—surely are fruits precious enough to satisfy the most exacting of utilitarians.

Breadth in conception, thoroughness in method, rapidity and economy in execution—these were the characteristics of the Survey when an enlightened and generous supervision gave assistance and support to the administration of such Superintendents as Hassler, Bache, Peirce, Patterson, Hilgard and Mendenhall; and to the honor earned by the services of the Survey to commerce and science must be added the credit due to the firmness with which its chiefs regulated their management in accordance with the highest form of what is now called Civil Service Reform.

The first appointment of a Superintendent qualified by no previous scientific experience for his position was made in 1885, but fortunately the appointee was a man of discretion, broad in his views and judicious in temperament. In attending to the professional details of the work the views and opinions of the most experienced and ablest of his scientific assistants were secured and given weight; his best efforts were called forth for the welfare of the Survey, and when he offered his resignation he surrendered his position with the knowledge that his honesty and fairness had won him the respect of his associates, to whom he had come a stranger, and that his stay had been the means of preserving the Survey from the machinations of scheming spoilsmen.

President Harrison during his term in the Senate had acquired a personal knowledge of the operations of the Survey and a strong appreciation of the requirements that should be satisfied by a proper head for it, and to the making of such a selection it is well known that he gave an unusual amount of personal attention, the result being the happy choice which fell on Dr. T. C. Mendenhall. To the readers of SCIENCE it would be an act of supererogation to recapitulate the qualifications of this distinguished scientist for the position, and no act of Mr. Harrison's administration reflected more credit upon his judgment than the selection he made for Superintendent of the Coast and Geodetic Survey. The influence of the new chief was at once felt in every division of the office, as he brought to his supervision not only a trained scientific mind, but the ripe results of a personal experience with nearly every line of work in the Survey, with the consequence that at no time in its whole history was the Survey more productive in original and practical results than for the term that Dr. Mendenhall was allowed control of the Bureau.

With the change of administration in 1893 came a return of the hostile spirit with which the Survey was treated in 1885. The President, it is true, appreciated the abilities of the Superintendent, the great work he had done, recognized his suitability and expressed his desire that he should remain; but the capture of a bureau where partisanship had never reigned was too tempting a prize to be lost for the new ruler that held sway in the Treasury Department. Left with only the semblance of executive power, and subjected to the pettiest and most odious treatment, Dr. Mendenhall remained

at his post until he had thwarted the most serious attack made in years on the integrity of the Survey, and then resigned an office his self respect could not allow him to retain.

In the successor to Dr. Mendenhall the Treasury Department was fortunate enough to find a professional gentleman who showed the accommodating spirit with the clerical idea of how a scientific bureau should be conducted that the layman, Mr. Thorn, failed in. The new appointee, General Duffield, was a civil engineer in active practice, but so far as has been shown none of his experience has been in connection with the special lines of work for which the Coast Survey has been noted. He had been employed in the construction of railroads, in operations under the United States Engineers and in contract land surveying; but seventy years had passed over his head at the time of his appointment without making his name a familiar one outside of his own vicinity. The professional career of the new Superintendent would indicate, if not expert knowledge of, at least intelligent sympathy with, the needs and requirements of his new charge; but his attitude from the very first showed that this was not to be the case. For inspiration as to what should be his general policy in the Survey he took the directions of the Chief Clerk of the Treasury Department; for special information he drew, not on his assistants, but on the recent appointees in the clerical positions, whose places in the Bureau were due to the same generous hands which had benefited himself. As the only places in the office, unprotected by civil service laws, which had not been filled by the new administration were those of the scientific force, upon them a raid was next to be made.

With only a little over nine weeks' experience in an office to whose duties he had come an entire stranger, and without any consultation with his natural advisers, the Superintendent wrote a letter to Congress, strongly advising a reduction of 20 per cent. in the field force. This wild suggestion was ignored by the Senate, where long service had made the needs and requirements of the Survey best appreciated, but the insistence of the House of Representatives on general economy at any cost led to a compromise whereby a reduction of force was secured.

The assistant in charge of the office, who had had that important position under Mr. Thorn and Professor Mendenhall, had the temerity to protest against the action of a Superintendent who had never drawn up an estimate for a year's work on the Survey and had never been called upon to consider the requirements, in men, for a season's work of the field parties, and his reward for his honesty and manliness in putting the welfare of the Survey above consideration for his own safety was a prompt request for his resignation. A lucrative berth was required for the Superintendent's son and to provide it an assistant was dismissed, and to secure for this young man, with no training in the distinctive work of the Survey, one of the highest salaries paid by the Treasurer, a reduction of $500 per year was made in the pay of the Geodesist who had connected the Pacific and Atlantic slopes by the grandest scheme of triangulation ever executed.

When the time for carrying into effect the requirements of the new appropriation bill arrived the full measure of the Superintendent's qualification for his position became apparent. The bill necessitated the retirement of four assistants. The Superintendent determined to remove eight; but two received by accident notice of the fate intended for them and had time enough to bring to the notice of the Secretary of the Treasury such strong presentation of the injustice intended them that he interfered

in their behalf, and only six were undefended before him and dismissed.

If it was only for his treatment of one of these gentlemen the Superintendent stands overwhelmingly condemened for absolute unfitness for the place he holds. Among these dismissed assistants was Professor George Davidson, sound in health, active in mind, the most distinguished member of the scientific force of the Bureau, a man of international reputation and the staunchest reliance of every Superintendent from Bache to Mendenhall. For fifty years his life was one of indefatigable industry, his record one of honor and distinction in every line of work he has been engaged in. Dean of the scientists on the Pacific Coast, delegate to the International Geodetic Association, member of the National Academy of Sciences, and with a name connected with every piece of Coast Survey work from the Aleutian Islands to San Diego, a man who had deserved every distinction that could be earned in the Survey, he was rewarded for a half century of the highest class of work by a dismissal which went into effect in one hour after notice of it was received.

Just before the last sweeping extension of the civil service regulations took the scientific places in the Coast Survey out of the reach of spoilsman a last effort was made to utilize a power which was now to be lost forever, but the Secretary of the Treasury showed his appreciation of the inopportuneness of so shameless an exercise of spoliation by allowing the removal of one efficient and respected officer instead of the three that the Superintendent intended to dismiss.

It is true that the recent extension of the civil service regulations render it improbable that such unjustifiable and disorganizing action will again be possible; but the memory of his subserviency to the policy of spoliation, and the knowledge of the utter lack of sympathy he has shown for the work and needs of the Survey, preclude any hope of usefulness from the present Superintendent in the future.

The duties of the Superintendent, when properly executed, form a burden for the strongest of men; they broke down the strength of Hassler, Bache, Patterson and Hilgard; and Professor Peirce, the greatest American mathematician of his day, found them too great to sustain. To their assumption came the present incumbent, with no previous experience of them, already burdened with the weight of 70 years and, as events have proved, with a mind which had lost its elasticity and entirely unequal to the task of mastering the great requirements that were demanded in a Superintendent. A mind of the first order would have been capable of this mastery; a younger man, talented and receptive, would have recognized that until time and study had remedied his deficiencies a frank demand for the advice and views of the assistants who had grown gray in work which had earned the commendation of all qualified to pass upon it was not only due to the best interests of the government, but was most advantageous for himself. Men of the first class appear rarely; that he was not of the second the course of the Superintendent makes evident to everyone; failing in both, the necessity of replacing him by a competent successor is a self-evident proposition. That the successor should have the confidence and suffrages of scientific men needs no better argument than the results which have followed as a consequence of the appointment of the present incumbent.

We need enumerate but a few of the measures and demands made on the Coast Survey to convince the general public of the necessity for an unusually capable man in the Superintendency; there are the ordinary surveys and the questions of necessity for new and minuter resurveys where the

commerce and defense of the coast seem to demand them; there is the question of the places for an economical and adequate survey of the vast shore line of Alaska; the assignment of officers to make the necessary surveys for disputed State boundaries and to sit on commissions for the establishment and improvement of harbors; and there is the provision of the astronomic, the gravimetric, magnetic, hypsometric and geodetic connections which will bring into an accordant whole the different surveys which the growth of our country and our rank as a civilized people are inevitably forcing us to provide.

Our bankers and merchants scan jealously the qualifications of every man suggested for a place of responsibility connected with the conduct of the public financial policy. Does not a similar interest call upon scientific men to insist upon a worthy chief for a bureau whose results form so large a measure of the amount of merit they can claim for the value of scientific application in public affairs and of the reputation due our country for her additions to the sum total of human knowledge?

But that the desirable man may be had in this case it is necessary that the innovations in the spirit of the management in this Bureau that date from 1885 should be changed. The scientific bureaus of the government, to be properly officered, cannot be treated as part of the prey from which the victors in political wars can reward their most energetic supporters. Their chiefs will never fail in patriotic devotion to the best interests of their country because they neglect to emulate the ostentatious devotion of the man working for an office.

From the political scientist, bound by the rules of the game to suffer the vicissitudes of party strife, what can be expected but a perfunctory attention to the affairs of an office whose details his term of official life gives but little promise that he will be given sufficient time to master? If our country wishes for the reward and fame that accrued from the labors of Hassler, Bache, Maury, Henry and Baird it must perpetuate the policy that fostered their genius; the direction of the great scientific bureaus must be placed in the hands of capable men, and to these chiefs the same measure of protection must be accorded that now safeguards their subordinates. J.

THE AMERICAN MORPHOLOGICAL SOCIETY.

The seventh annual meeting of the American Morphological Society was held at the Harvard Medical School, Boston, December 29, and at the Museum of Comparative Zoology, Cambridge, December 30, 1896. The following persons were elected to membership: Dr. G. Lefevre, Johns Hopkins University; Dr. A. Schaper, Harvard Medical School; Dr. E. E. Bickford, Vassar College; Dr. W. E. Castle, Knox College; Dr. A. W. Weysse, Massachusetts Institute of Technology; Dr. A. G. Mayer, Harvard University; Dr. J. H. Gerould, Dartmouth College; Dr. H. S. Jennings, Jena; Dr. H. V. Neal, Munich; Miss Margaret Lewis, Radcliffe College; Dr. Ida Hyde, Cambridge; Mrs. G. C. Davenport, Cambridge; Dr. H. McE. Knower, Williams College; Dr. C. M. Child, Chicago University; and Dr. E. L. Rice, Allegheny College.

The following communications were presented and discussed:

The Individuality of the Cell. Arnold Graf.

The paper formulated a cellular theory opposed to the classical theory of *Schleiden* and *Schwann*, and to the Tolioplasma theory of *Nägeli* and *Whitman*, in the following terms:

1. The cell is a physiological but not a morphological unit.

2. It consists morphologically of numerous lesser units, which pertain to different categories, being specifically irritable by varying stimuli.

3. The sum total of the energies of these lesser units constitute cellular life.

4. Differentiation is caused by specific irritation of certain kinds or elementary units, instigating these to multiplication and therefore to supremacy over the other units.

5. The cell does not lead a double life; it leads only one life, namely, an independent life. There is, in fact, only one life that we know of.

6. The axiom that a function presupposes cellular structure is not proved. Structure presupposes function is more acceptable, as it may be supported by direct evidence. Cellular structure becomes more complicated if the function of the cell is more energetic.

7. Structure is a side product formed during the exchange between stimulus and reaction. (Was supported by examples from the organic and inorganic world.)

8. The elementary units of the cell are partly demonstrated in the microsomes, chromatin granules and centrosomes. The microsomes are of different kinds, some of which were demonstrated by slides.

1. *Origin of the Centrosomes in the Unfertilized Egg of Chætopterus.*

2. *The Behavior of the Centrosomes during the Maturation and Fertilization of Chætopterus.* A. D. MEAD.

There is in the egg of Chætopterus a definite body, the centrosome, which is not an artifact, and which is not identical with the centrosphere or astrosphere, though the latter is sometimes present.

In the 'oöcite of the first order,' *i. e.*, the unmaturated egg, the centrosomes arise by a modification of pre-existing cytoplasmic structures. Those of the first and succeeding cleavage spindles are identical with, or derived directly from, the male centrosomes, which are probably brought into the egg with the middle-piece of the spermatozoön.

The centrosomes, whatever their origin, are capable of growth and multiplication and persist through at least several cell generations.

There is no union of male and female centrosomes during fecundation—no 'quadrille of the centers.' The female centrosomes entirely degenerate, and therefore cannot be considered a special means for conveyance of hereditary qualities.

The centrosphere, a differentiated region about the centrosome, gives a different reaction from the centrosome, on the one hand, and the rest of the cytoplasm, on the other, both in point of color and resistance to certain reagents. Corrosive-acetic and certain other reagents will sometimes completely destroy the centrosphere, though the rays and other structures are fairly well preserved.

The centrospheres, unlike the centrosomes, appear and disappear with each succeeding karyokinesis. When they are present the cytoplasmic rays of the aster are not so strongly developed as when they have disappeared and the rays diverge directly from the centrosomes themselves.

The centrosomes divide and move apart within the centrosphere for a considerable distance without altering the spherical shape of the latter structure.

On the Origin of the Centers of the First Cleavage Spindle in Unio Complanata. F. R. LILLIE.

After the formation of the second polar body the inner centrosphere and a large part of the aster become converted into archoplasm, against which the egg nucleus lies. The archoplasm is vesicular (or reticular) in structure, and contains the centrosome, though the latter cannot be distinguished on account of the entire disappearance of radiations. The sperm nucleus

lying in the egg substance is, at this time, perfectly naked, *i. e.*, unaccompanied by archoplasm or radiation of any sort. As the sexual nuclei approach each other, radiations appear around the centrosome in the archoplasm; or these radiations appear first after the nuclei have met. *There can be no doubt in either case that the centrosome around which they appear is the egg center*, seeing that it lies within the archoplasm, which always accompanies the egg nucleus. The centrosome then divides in two, forming the amphiaster of the first cleavage.

The egg and sperm nuclei never fuse to form a single vesicular cleavage nucleus, but each forms its own group of sixteen chromosomes.

The study of the earlier stages shows, that the sperm head is accompanied soon after its entrance by a comet-like aster, with a minute centrosome. *This centrosome divides and forms an amphiaster, which entirely disappears in the late anaphase of the first maturation spindle. The sperm centrosomes never become functional again.* But a supernumerary central aster appears near the center of the egg during the metaphase of the second maturation spindle. This aster also disappears during the anaphase of the same spindle.

Thus the mode of fertilization in Unio agrees with that in Myzostoma, in so far as the centers of the cleavage spindles are derived from the ovum, but differs from it in as much as the spermatozoön in Unio brings in a centrosome, whereas the spermatozoön of Myzostoma does not introduce a centrosome into the ovum. Unio is thus in a certain sense intermediate between Myzostoma and those forms in which the sperm centrosome forms the active centers of the cleaving ovum.

Centrosome and Middle-piece in the Fertilization of the Egg. E. B. Wilson.

In an earlier paper the author had described the sperm-aster in *Toxopneustes* as arising about the middle-piece of the spermatozoön as a center. Within the central mass thus formed no constant central granule could be found; the conclusion was therefore drawn that the middle-piece as a whole must be identified as the centrosome. Later studies on material differently fixed show that this conclusion was erroneous. In eggs fixed in picro-acetic and weak sublimate-acetic (1–5 per cent. acetic) the middle-piece stains intensely black and its entire history can be accurately followed in sections. As the sperm nucleus moves inward the middle-piece separates from the nucleus, is left behind, and finally breaks up and degenerates. The astral rays are thus found to focus at a point lying at the base of the nucleus, between it and the middle-piece. At this point is an extremely minute intensely shining granule, which undoubtedly is the centrosome, as described by Boveri, von Rath, Hill and Kostanecki. The centrosome occurs in the same form in *Arbacia* and *Asterias*. In some cases the sperm-aster and centrosome move away from the nucleus before the latter has separated from the middle-piece. These facts demonstrate that the middle-piece proper is not the centrosome, and that the latter is an infinitesimal granule which lies either inside the middle-piece or between it and the nucleus.

In *Arbacia* the sperm centrosome can be traced continuously though the first cleavage into the 2-cell stage, as in *Chætopterus*, *Thalassema* and *Physa;* and precisely as in those forms in the late anaphases each cleavage centrosome, after doubling, gives rise to a daughter-amphiaster and central spindle which are, however, of extraordinary minuteness. In *Toxopneustes*, after exactly the same treatment, the result is apparently different, agreeing in substance with the author's earlier studies and with the accounts of Boveri and Reinke. In the 'pause,'

after fusion of the sperm-aster, a single 'centrosome' is found at the center of each aster. In later stages the center of the aster is occupied by a well-defined reticulated sphere, somewhat smaller than is the case after strong sublimate-acetic, and containing a group of distinct intensely shining granules (10–20 in number). The central sphere often has a sharp boundary and gives almost the appearance of a minute cell nucleus. Whether this appearance is normal remains to be seen, but the possibility must be born in mind that even related forms may differ considerably in respect to the morphology of the centrosome and centrosphere.

Observations upon Fertilization in Gasteropods. H. E. CRAMPTON, JR.

The observations were made upon a species of Doris collected on the Pacific coast and upon a species of Bulla from Wood's Holl. A complete confirmation was obtained of the accounts of fertilization given by Wilson and Matthews, Boveri and Hill upon sea urchins, Mead upon *Chætopterus*, Kostanecki and Wierjeroski upon *Physa*. The sperm nucleus is preceded by the divided centrosome, although an aster is not formed till after the union of the germ nuclei. The first polar spindle of the egg has a double centrosome at the poles, while the second maturation spindle bears but a single centrosome at the pole. These, however, are very large, and the one remaining in the egg finally breaks up, the centrosomes of the cleavage spindle being derived from the sperm. The germ nuclei never fuse, but lie in very close contact to one another.

The Maturation and Fertilization of the Eggs of Limax. E. F. BYRNES.

After leaving the ovo-testis, the eggs of *Limax agrestis* are stored in the albuminous gland, where they are fertilized prior to the formation of the capsules.

By the time the egg reaches the albuminous gland the first polar spindle is already formed and occupies the middle of the egg (the stage of the 'archiamphiaster').

The center of the egg-astrosphere appears under widely different forms. In the stage of the archiamphiaster it appears as a central group of granules surrounded by two sharply outlined, homogeneous envelopes, an inner colorless envelope and an outer deeply staining one.

At the time of the formation of the first and second polar bodies the center of the astrosphere appears as a deeply staining center, surrounded by an almost colorless envelope from which the astral rays diverge.

After the extrusion of the first polar body it appears as a uniform finely granular sphere in which two tiny centrosomes are often distinguishable.

After the extrusion of the second polar body the center of the aster appears as a large, clear, spherical structure, traversed by a loose reticulum which connects, at the center of the sphere, with a large, deeply staining body. As the sphere increases in size the central body fades out, giving place to a reticulum which occupies the entire sphere. The egg-astrosphere then disappears.

The sperm enters the egg at the lower pole. As the sperm nucleus approaches the upper pole it keeps pace with the growth of the egg nucleus.

The centrosome of the segmenting egg enters the egg with the sperm, but the time of the appearance of the sperm-asters is variable.

1. *A New Microtome.*
2. *Laboratory Methods.* C. S. MINOT.

A new microtome was exhibited and its mode of working described; methods for polishing the edges of microtome knives, for storing pamphlets, and other matters of laboratory administration, were presented.

The Preservation of Cartilage and other Tissues in a Dried Condition. W. PATTEN.

The cartilaginous crania and other parts of the skeleton of the skate, when perfectly dehydrated, may be cleared in benzole, turpentine or chloroform, and impregnated with paraffine in the usual manner preparatory to sectioning. But if, instead of imbedding them in a block of paraffine, they are drained in the warm oven for a few minutes, or wiped off quickly with blotting paper and then allowed to cool, they harden very quickly, with little or no shrinkage, and show very clearly the important anatomical details.

Complete dehydration may require days and even weeks of immersion in strong alcohol, to which pieces of calcium oxide are added to absorb the water given off by the tissues. In very difficult cases prolonged heating or boiling in alcohol may be necessary.

If the dehydration is not complete the objects will shrink when placed in paraffine. But in some cases the shrinkage will not appear till three or four weeks after exposure to the air. Paraffine that has been used before and contains oil of cloves, etc., discolors the tissues. The same is true of turpentine. When one wishes to preserve the clear, white color of the tissues the best results are obtained by using perfectly clear alcohol, chloroform and pure paraffine. The method has not been thoroughly tested, but there seems to be no reason why we cannot prepare in this way the entire skeletons of animals, whether in whole or in part cartilaginous, and entire embryos or adult animals, when not too large.

In this way series of amphibian eggs were prepared, which when fastened to a card are very useful in the laboratory; also a series of sections about $\frac{3}{176}$ of an inch thick from a horseshoe crab eight inches long. The sections are cut before dehydration and impregnated with paraffine afterwards. When the paraffine collected in exposed cavities (blood sinuses, elementary cavities, etc.), and would not drain off readily, it was absorbed while hot by a bit of blotting paper.

If the object is too large to be imbedded safely it may be cut open or sliced down approximately to the desired plane before dehydration and then heated, as described above. The imbedded pieces may then be cut down to the requisite level in the microtome, and, if necessary, heated again to drain off the excess of paraffine. Excellent sagittal sections of the brains of fishes were obtained in this way, showing very clearly the ventricles and their connections. The same method might be easily applied to show the structure of sea anemones, earth worms, mammalian embryos, etc.

G. H. PARKER,
HARVARD UNIVERSITY. *Secretary.*

(*To be concluded.*)

ZOOLOGICAL NOTES.

THE FLORIDA MONSTER.

I HAVE just received some large masses of the carcass cast ashore in December and described by me as the body of an *Octopus* in the *American Journal of Science* and elsewhere. These masses of integument are 3 to 10 inches thick, very tough and elastic, and very hard to cut. They are composed mainly of tough cords and fibers of white elastic connective tissue, much interlaced. This structure resembles that of the blubber of some cetaceans. The creature could not have been an *Octopus*. It was probably related to the whales, but how such a huge bag-like structure could be attached to any known whale is a puzzle that I am unable to solve at present.

The supposition that it was the body of an *Octopus* was partly based upon its bag-like form and partly upon the statements made to me that stumps of large arms were attached to it at first. This last statement was certainly untrue. A. E. VERRILL.

FEBRUARY 23, 1897.

A NEW SUBGENERIC NAME FOR THE WATER HARES (*hydrolagus* GRAY.)

MR. FREDERICK W. TRUE has called my attention to the fact that the name *Hydrolagus* used subgenerically by me in a recent paper on American Hares* is preoccupied in Ichthyology, the case standing as follows:

Hydrolagus GILL, Proc. Acad. Nat. Sci., Phila. for 1862, p. 331.

Hydrolagus GRAY, Ann. and Mag. Nat. Hist., 3d ser., XX., 1867, p. 221.

There being no synonym of Gray's preoccupied *Hydrolagus* to replace it, the name *Limnolagus*, new subgenus, is therefore proposed for the group of Water Hares, of which *Lepus* [*Limnolagus*] *aquaticus* Bachman will be the type.

This section of *Lepus* was originally characterized by Baird (Mammals of North America, 1857, page 575), as follows: "F. Skull and incisors very large and massive; muzzle about as wide as high. Post-orbital process completely fused with the skull for its entire length, leaving neither foramen, notch nor suture, *L. aquaticus* [and *L.*] *palustris.*" The above diagnosis, supplemented by additional characters given by Baird in his Key to the North American species of *Lepus* at the top of page 577, has since been repeated, with some modifications, by Gray (who raised Baird's section 'F.' to generic rank), Allen and myself.

EDGAR A. MEARNS.

U. S. ARMY.

CURRENT NOTES ON ANTHROPOLOGY.

WOMAN IN CHINA.

PROF. GUSTAVE SCHLEGEL, of Leyden, contributed to the 10th International Congress of Orientalists a charming study (in French) on the position of woman in China, in times past and present. Truly, as he points out, she enjoys there in many respects an influence greater than with us. The Emperor of China to-day, in theory at least, does nothing but carry out the orders of his mother! The conjugal position of the wife is, as a rule, dignified and important; and when she is unhappy it is nearly always a case of two much mother-in-law.

In the past Chinese women have occupied prominent rank in literature and the fine arts. They have been poets and writers of history, and indirectly have directed government. Even in the most ancient monuments of Chinese literature we do not discover any expressions which indicate that women were kept in a servile condition

DEATH MASKS IN EUROPE AND AMERICA.

Two interesting contributions to the study of death masks have recently appeared. One is by Mr. F. S. Dellenbaugh, in the *American Anthropologist* for February, on the faces of the dead so accurately reproduced on vases from Arkansas. These, he argues, were, in fact, not hand work, but obtained from moulds actually taken from the visage of the corpse. In no other way, he believes, can we explain their striking accuracy.

In *Folk-Lore* for December, 1896, the Hon. J. Abercromby treats of funeral masks in Europe. The custom still prevails in various localities to cover the face of the dead with such a mask during the funeral ceremonies, though sometimes the mask is placed not on the face, but besides the corpse. His explanations of the custom in some of its details are not convincing, and probably we have not yet caught the exact spirit of remote ages on this point.

ONTARIO ARCHÆOLOGICAL REPORT.

THE annual report (1896–7) of the Ontario Archæological Museum contains some matters of unusual interest. The first is a careful description of the Otonabee serpent

*Preliminary description of a new subgenus and six new species and subspecies of Hares from the Mexican border of the United States. Proc. U. S. Nat. Mus., Vol. XVIII., No. 1081, pp. 551–565, 1896.

mound, by the Curator, Mr. David Boyle. A photographic illustration and a plan are added. There is no doubt of its artificial origin and religious character, and it even resembles the Ohio serpent mound in the presence of the 'egg' in front of the serpent's head. Efforts will be made to preserve it. A number of other mounds and some graves are described, and a variety of noteworthy specimens acquired by the Museum are mentioned and illustrated. At the close of the report (which covers 117 pages) is a useful bibliography of the archæology of Ontario, prepared by Mr. A. F. Hunter.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

The last number of the Proceedings of the Chemical Society contains the abstract of a paper by W. N. Hartley and H. Ramage on the wide dissemination of some of the rarer elements. A large number of ores and minerals were examined by means of spectrographic analysis. Most notable is the wide distribution of gallium, which was found in 68 out of 168 specimens, occurring in most magnetites, bauxites and blendes, and nearly half the clay ironstones and manganese ores. Rubidium appears to be even more widely distributed, occurring in most iron ores. Indium was found in thirty minerals, including all the carbonates of iron and tin ores and most blendes. Thallium, while less widespread, was frequently found. Iron and sodium were found in every specimen and potassium in all but two, one a blende and the other a tin ore. Calcium, copper and silver were found in all but a few cases. Such a wide dissemination of gallium and indium is unexpected, and the same might be said of silver. Among metals not looked for by the authors, titanium is known to be found almost universally, and possibly the same is true of gold.

An interesting class of substances has been discovered by Professor Wm. L. Dudley, of Vanderbilt, formed by the action of fused sodium dioxid on metals. The one most carefully studied is a hydrated oxid of nickel, of the formula $Ni_3O_4,2H_2O$. It is formed by heating nickel with sodium dioxid in a nickel crucible to a cherry red. The surface of the fusion soon becomes covered with scaly crystals, which, after cooling and washing, possess the composition given. They are lustrous, almost black, apparently hexagonal plates, soft and somewhat resembling graphite. They begin to lose water at 140°, and thus present the curious but not unique phenomenon of a substance containing water, formed at a high temperature and losing its water at a much lower temperature. Other metals appear to form similar compounds, but their study is not easy, since fused sodium dioxid attacks crucibles of porcelain, iron, silver, gold or platinum.

Before the Edinburgh University Chemical Society on January 25th a paper was read by Dr. Dobbin on 'Who introduced the use of the balance into chemistry?' After quoting from text-books many statements which attribute to Lavoisier the discovery of the law of conservation of energy, and the first employment of the balance in investigating theoretical questions in chemistry, the author showed that every step of Black's classic investigation on 'Magnesia Alba' was made good by appeal to direct quantitative experiments. Boyle also made frequent use of the quantitative method of experiment. The earliest attempt to determine the accuracy of a view by appeal to quantitative experiment was, according to Dr. Dobbin, that of Van Helmont in his well-known experiment upon the supposed formation from water only, of 164 pounds weight of the substance of a willow tree, the weight of the earth in which this willow grew having varied by only about two

ounces in five years. Van Helmont's work was most probably the inspiration of that of Boyle, and Lavoisier is well known to have been an attentive student of the works of the latter. Thus must we trace the evolution of the 'Father of Chemistry!'

J. L. H.

SCIENTIFIC NOTES AND NEWS.

VERTEBRATES FROM THE KANSAS PERMIAN.

VERY recently I have received from Cowley County, Kansas, a number of fossil bones obtained in an excavation for a well, which are of considerable stratigraphic interest. They are from near the base of the Permian, as defined by Professor Prosser, who is our authority on the stratigraphy of the Kansas Permian. Two of the animals represented by the remains are indistinguishable, so far as the descriptions show, from *Cricotus heteroclitus* and *Clepsydrops collettii*, described by Cope from the Permian of Illinois; with them, also, are numerous teeth, similar to or identical with an Illinois species of *Didymodus*.

That species of vertebrate animals are good 'Leitfossilien,' there can be no question, thus proving the contemporaneity of the Illinois and Kansas deposits. Furthermore, all of these genera are represented by closely allied forms from the Permian beds in Texas, which would therefore seem to be of earlier rather than later Permian time. Above the strata which yield these remains in Kansas there are two or three hundred feet of shales and limestones underlying, whether conformably or not is not known, not far from one thousand feet of deposits known as the 'red beds.' That these red beds are not contemporaneous with the Texas Permian would seem assured, and I feel yet more confident that they are, what they were first considered to be, of Triassic age.

S. W. WILLISTON.

A NEW BOTANICAL LABORATORY IN THE AMERICAN TROPICS.

A MOVEMENT for the establishment of a botanical laboratory in the American tropics which should be international in its organization and benefits had made such progress in the way of securing substantial support that the writer at the suggestion of the editors of the *Botanical Gazette*, on January 1, 1897, began to organize a commission for the selection of a location for the proposed laboratory, and to ascertain how far the moral support and active cooperation of American and British botanists might be enlisted.

The organization of the commission has proceeded with such facility that the American membership is now complete, with the following representation:

Professor Douglas Campbell, Stanford University.
Professor J. M. Coulter, University of Chicago.
Professor W. G. Farlow, Harvard University.
Professor D. T. MacDougal, University of Minnesota.

It is proper to say that the entire movement has received the support of almost every active botanical center engaged in work which would be benefited by the opportunities afforded by a tropical station—a unanimity that points to a speedy establishment of the proposed laboratory.

Preliminary to the beginning of actual field work, advices have been secured concerning the regions which should receive the attention of the commission, from botanists in Germany, England and America, inclusive of the gentlemen in charge of the various tropical and subtropical stations now in existence. The suggestions made include the Pacific Coast from California to Peru, the Gulf Coast from Galveston to Panama and from Florida to Venezuela.

Data concerning the climatic conditions, flora and transportation facilities are being accumulated, and the commission will be able to select the region best adapted for the purposes of the laboratory before starting on its tour of inspection. The work of the commission in the field will consist in the selection of a site offering the most highly advantageous grouping of local conditions. The presence of a body of undisturbed tropical vegetation, easily accessible from a site, conveniently placed with reference to towns or settlements, or other base of supplies, as well as direct and easy connection with a marine sub-station, will be the more essential features.

The commission will be present at the meetings of the A. A. A. S. at Detroit and the British Association at Toronto in August, and will make an informational report to these bodies if desired.

D. T. MacDougal.

AN ALLOY COMPOSED OF TWO THIRDS ALUMINUM AND ONE THIRD ZINC.

Prof. W. F. Durand, of Sibley College, Cornell University, supplied the following facts:

From a series of tests made in the Mechanical Laboratory of Sibley College, on the strength of alloys of aluminum and zinc in varying proportions, the best results were found for mixtures of not far from the above proportion. The principal properties of the metal were found to be as follows:

Tensile strength deduced from small bars	22,000
Maxium fiber stress deduced from transverse tests	44,000
Modulus of elasticity	8,000,000
Specific Gravity	3.3

Apart from of the above, comparative experiments have been made more recently between small bars of this metal and like bars of cast iron, showing the same general indications, and apparently warranting the conclusion that this alloy is the equal of good cast iron in strength, and its superior in location of elastic limit. The other general physical properties of chief interest are as follows:

The color is white and it takes a fine smooth finish and does not readily oxidize. It melts at a dull red heat or slightly below, probably about 800–900 F. It can, therefore, be readily melted in an iron ladle over an ordinary blacksmith's forge or other open fire. It is very fluid and runs freely to the extremities of the mould, filling perfectly small or thin parts. In this particular it is much superior to brass. It does not burn the sand into the casting and hence comes out clean and in good condition to work. It is rather softer and more easily worked than ordinary brass, and yet is not as liable to clog a file. It is brittle like cast iron and hence is not suited to pieces which require the toughness possessed by brass. For equal volumes and with aluminum at 50 cts. per pound, it is about equal in expense to brass bought at 15 cts. per pound.

This alloy would seem to be admirably adapted to many small parts of machines, models, etc., where it is desired to obtain castings without waiting for a regular foundry heat, and where lightness combined with good finish, strength, stiffness and non-corrosiveness, are among the desiderata. It has been employed with great success in the construction of small screw propellers for experimental work in the Graduate School of Marine Engineering.

GENERAL.

The author of 'The Argentaurum Papers' has brought suit against this Journal for $50,000, estimating that his reputation 'as a scientist, philosopher, chemist and mathematician' has been damaged to that extent by the review of his book in our issue of February 19th (p. 314). Should the 'case' prove one for the legal profession, the Supreme Court of the State of New York may need to pass on the validity of the law of gravitation.

The American Society of Naturalists, the American Physiological Society, the American Morphological Society and the American Psychological Association will meet at Cornell University, Ithaca, N. Y., on December 28, 29 and 30, 1897.

At the annual meeting of the New York Zoological Society, in January, the Board of Managers was strengthened by representatives from the American Museum of Natural History and from the New York Botanical Garden. The resignation of the Honorable Andrew H. Green, who has been President of the Society since its inception, was accepted, and the selection of his successor was left to the Executive Committee. This Committee was reorganized for the year by the election of Henry F. Osborn as Chairman and Madison Grant as Secretary. At the last meeting of the Committee the Hon. Levi P. Morton, of New York, was elected President of the Society. The other officers of the Society are: Corresponding Secretary, George Bird Grinnell; Treasurer, L. V. Randolph. The agreement with the City has been in the hands of the Park Board for nearly six weeks, and has undergone considerable modification, mainly in the direction of giving

the Society greater autonomy in the administration of the proposed Zoological Park. The Commissioner and other members of the Sinking Fund Commission, as well as members of the Park Board, have all declared themselves individually in favor of the proposals of the Society, and it is expected that a satisfactory settlement will be reached in the course of a short time.

OFFICERS of the New York Academy of Sciences for 1897–1898, in most cases the same as for the past year, have been elected, as follows: President, John J. Stevenson, professor of geology, New York University; First Vice-President, Henry F. Osborn, professor of zoology, Columbia University; Second Vice-President, Nathaniel L. Britton, director New York Botanical Garden; Corresponding Secretary, William Hallock, department of physics, Columbia University; Recording Secretary, James F. Kemp, professor of geology, Columbia University; Treasurer, Charles F. Cox; Librarian, Arthur Hollick, department of geology, Columbia University.

PROFESSOR C. S. SHERRINGTON will deliver the Croonian lecture before the Royal Society on April 1st, having selected as his subject, The Spinal Cord and Reflex Actions.

SURGEON H. D. GIDDINGS, United States Navy, the American scientific delegate to the conference on the plague, has arrived at Venice.

PROFESSOR EBERMANN has been elected President of the St. Petersburg Medical Society.

Nature quotes from the *Rendiconti del Reale Istituto Lombardo* the award of the following prizes: One of the five Cagnola prizes of 2,500 lire and a gold medal of the value of 500 lire to Dr. Andrea Giulio Rossi, of Padua, for his essay on methods of registering the phases of two alternating currents. The Brambilla prize of 1,500 lire and a gold medal are awarded to Prof. Carlo Figini, for his improvements in the weaving industry; and rewards of 500 lire each to Signor Sala Salvatore and Signor Scartazzi Antonio. The Fossati prize of 2,000 lire is awarded to Prof. Angelo Mosso, of Turin, for his essay on the temperature of the brain. For the coming year the Istituto offers the prize of the institution of 1,200 lire, for experiments confirming Maxwell's theory of dielectric stresses; six Cagnola prizes of 2,500 lire, each accompanied by a gold medal of 500 lire, for essays on various selected subjects, mostly medical; one Brambilla prize, for improvements in some industry in Lombardy, and one Secco-Comneno prize of 864 lire, for an essay on uræmia. These prizes are open to foreigners, but the essays must be in Italian, French or Latin.

A NEW laboratory for hygiene has been erected and recently opened at the University of Freiburg. It is under the directorship of Professor M. Schottelius.

THE Royal Meteorological Society, London, will hold from March 16th to 19th, in commemoration of the Diamond Jubilee of the Queen, an exhibition of the meteorological instruments in use in 1837 and in 1897, together with diagrams, drawings and photographs illustrating these.

LORD PLAYFAIR has written to the London *Times* suggesting that in addition to the various philanthropic and local plans proposed for the celebration of the Queen's jubilee the event be celebrated by a permanent national memorial out of public funds. He calls attention to the fact that in 1837, the first year of Queen Victoria's reign, a vote was taken and a museum and school of design were opened at Somerset House. This initial effort to promote technical education has developed into the magnificent art collections and art instruction of South Kensington. For the purpose of technical instruction in art these collections are superior to any in Europe. Berlin and Vienna have avowedly founded new museums on the English type, while Paris has rearranged her museums to some extent in a like way. The museum at South Kensington was opened in 1857, but while the collections have continually grown the building has never been completed. Lord Playfair proposes that Parliament complete the building and that the name be changed from the South Kensington Museum to the Victorian Museum.

LORD SALISBURY, the English Premier, received, at the Foreign Office, on February 16th, a deputation of representatives of science, who asked the government to establish a national

physical laboratory, at a cost of £30,000 for buildings, and £5,000 a year for maintenance. The deputation was introduced by Lord Lister, and addresses were made, urging the importance of such a laboratory, by Professor Rucker, Lord Rayleigh, Sir Douglas Galton, Mr. J. Wolfe-Barry and Sir Andrew Noble. Lord Salisbury, in reply, said that all must be heartily anxious for the attainment of the objects advocated, so far as they were practicable. He feared, however, that the demands might in the end greatly exceed those proposed by the committee. He thought it would be better to begin by determining standards which had already been acknowledged as a function of the state, and leave research to private munificence.

We have, on several occasions, called attention to the work of the Forestry Commission under the auspices of the National Academy of Sciences. This Commission has now selected thirteen new forest reserves, including altogether an area of more than 21,000,000 acres, and these have been set aside by President Cleveland as National forest preserves. Some years ago Congress authorized the Executive to withdraw from public sale parts of the forested public lands, and during Mr. Harrison's administration about 18,000,000 acres were thus set apart. The new reserves include the central portion of the Black Hills of South Dakota, the Big Horn Mountain Range in Wyoming, the Jackson Lake country south of the Yellowstone National Park in Wyoming, the Rocky Mountains of northern Montana, a forest region in northern Idaho, the principal part of the Bitter Root Mountain region in Montana and Idaho, the Cascade Mountains of northern and of southern Washington, the Olympic Mountain region in northwestern Washington, the Sierra summits of California north of the Yosemite National Park, the San Jacinto Mountains in southern California, and the Uintah Mountains in northern Utah.

The February number of the *Bulletin of the American Mathematical Society* gives a brief account of a Mathematical Conference held in the University of Chicago, December 31, 1896, and January 1, 1897, in response to a call issued by several members of the American Mathematical Society. Fourteen papers were read and a resolution was adopted to the effect that, in the opinion of the conference, it was desirable for the members of the American Mathematical Society to hold in Chicago at least two meetings a year for the reading and discussion of mathematical papers, one during Christmas vacation and one in the spring.

The proceedings of the American Association for the Advancement of Science for the forty-fifth meeting at Buffalo last August have been published by the permanent secretary. The volume appears at an earlier date than usual, probably owing to the omission of abstracts of the papers read before the sections. We have already published the addresses of the president and the vice-presidents and full accounts of the meeting. We may, however, quote the following facts from the report of the permanent secretary. The 333 members and associates in attendance were from the following States: New York, 92; Ohio, 31; Massachusetts, 29; District of Columbia, 23; Pennsylvania, 22; Indiana, 13; Iowa, 12; Michigan, 11, and less than 10 from each of twenty-seven States and foreign countries. The 270 papers presented before the sections were distributed as follows: mathematics and astronomy, 12; Physics, 32; chemistry 53; mechanical science and engineering, 18; geology and geography, 42; zoology, 22; Botany, 44; anthropology, 33; social and economic science, 13. Several important changes in the constitution have been proposed, which should be carefully considered by members before the next meeting.

The American Association for the Advancement of Physical Education has issued the first number of a new quarterly publication, entitled the *American Physical Education Review*, edited by the Committee on Publication, consisting of Dr. E. M. Hartwell, Dr. George W. Fitz and Mr. Ray Greene Hieling. The present number, which is a double one, extending to 128 pages, contains an article on Peter Henry Ling, the Swedish Gymnasiarch, by Dr. Hartwell, followed by articles on The Olympic Games, The Present Status of Physical Training, Physical Education in Brunswick, Military Drill in the Public Schools, Manual

Training, The Influence of Exercise on Growth, The Brooklyn Public Bath, and a report of a committee of the Boston Physical Education Society suggesting a substitute for the Manual of Arms as a means of physical exercise in the military training of school boys. There are also reports from local societies, editorial notes, book notices and an index of the proceedings and the reports of the Society issued during the past ten years. The American Society for the Advancement of Physical Education is accomplishing an important work, which will doubtless be increased by the publication of this review.

THE second annual report of Mr. F. A. Crandall, the Superintendent of Documents, is of considerable interest, more especially in view of the bill now before Congress. As everyone knows, a great number of important scientific papers and books are published each year by the government, but in such a manner as to lose a considerable part of their value. The documents are printed late and are often not bound and distributed for years after they have been printed. They are in large part given away where they are not wanted, while even their existence is unknown to many who would like to buy them. The present Superintendent has made great improvements in the publication of the Document Catalogue of the Fifty-Third Congress, and more especially in the issue of a monthly catalogue. The bill now before the Senate provides for uniform publication, so that there shall not be more than one original edition of each book. There are now often four editions of the same book bound in such a manner that no one could tell from the title on the cover that they are the same. The bill also provides for the more prompt binding and distribution of volumes. Other desirable provisions of the bill are that the publications of the several Departments and Commissions shall be bound in distinctive colors, so that their origin may be recognizable at sight; that the octavo size shall be used, except in unusual cases; that volumes shall be volumes and not parts; that series shall be series and not volumes; that gold leaf instead of base metal shall be used in lettering documents; that better cloth shall be used for binding than has sometimes heretofore been used; that sheep bindings for the library supply of public documents shall be abolished; that the back titles shall show the actual subject-matter of the books; that the bound volumes of Congressional documents and reports shall be paged consecutively through the volumes. The need of a reform is shown by the fact that during the year covered by the report nearly 200,000 documents were distributed, while only 3,581 were sold. Of many important publications, such as the *Memoirs of the National Academy of Sciences*, only one or two copies were sold. The *Monthly Catalogue* of public documents is for the present distributed without charge, and men of science should apply for this before the edition of 2,000 is exhausted.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. SWANTE PALM, Swedish Vice-Consul at Austin, has given the University of Texas his library of 25,000 volumes.

WE have received a letter from Dr. I. Maddison, Secretary to the President of Bryn Mawr College, calling attention to the fact that in the article on 'Science in College Entrance Examinations,' printed in the issue of this JOURNAL for December 25, 1896, Bryn Mawr College was not included in a list of those institutions recognizing a proper preparation in physical and natural science. Colleges for women were not considered in the report in question, but we are glad to state that in this as in most other respects Bryn Mawr College has followed the admirable example of the Johns Hopkins University. As Dr. Maddison writes: "Bryn Mawr College has from its foundation included science in its entrance requirements. Some slight changes have been made in the regulations from time to time, but the latest program states that candidates for matriculation must be examined in the elements of one of the following sciences: Physics, chemistry, botany, physiology or physical geography. No student can obtain an A. B. degree at Bryn Mawr College without having attended lectures in science (biology, chemistry, physics or geology), for at least five hours weekly for one year, and doing, in connection with the science chosen, the prescribed amount of laboratory work."

DISCUSSION AND CORRESPONDENCE.

'AN AMBITIOUS PARADOXER.'

HISTORY tells us of a man whose great pride and boast it was that he had once been kicked by the Duke of Wellington. Mr. Stephen H. Emmens, whose advertisement appears in SCIENCE of February 19th, seems to be moved by a like ambition, only, the great Duke being dead, he has to get men of lower rank to perform the ceremony. Only thus can I explain his advertisement in which he cites a number of names of scientific men, my own among them, as having written in such a manner 'as to show that they regard his arguments and mathematical demonstrations as incapable of refutation.'

I have never even seen Mr. Emmens' book, and experience taught me long years ago that any attempt to cure that special mental condition of which he is a victim by reasoning or explanation was futile. I therefore have long ago made it a rule neither to address any argument or comment to that class of people, nor tell them what I think of their vagaries. To fill the cup of Mr. Emmens' happiness, I shall only add that he is entitled to the highest place in the class to which he belongs.

S. NEWCOMB.

FORMER EXTENSION OF GREENLAND GLACIERS.

FROM Professor Tarr's letter in the last number of SCIENCE, under the above heading, it would appear that he is disposed to insist upon an erroneous interpretation of the views of Professor Salisbury and myself after the error has been explicitly pointed out. It appears that on the basis of my general inference "that the ice formerly so extended itself as to reach the coast over about half its extent, while in the remaining portion the ice fell short," Professor Tarr inferred that the area which he studied fell within the portion in which the ice did not reach the coast. He further assumed that the augularity of outline which he observed in a region which had been glaciated was the angularity from which we inferred non-glaciation. In the editorial in the *Journal of Geology*, to which he refers, it was explicitly pointed out that the region between Disco Island and Melville Bay, within which Professor Tarr's studies lay, was regarded by both Professor Salisbury and myself as having been glaciated in general. Only some of the higher peaks which were not visited by Professor Tarr, and which rose to heights greater than any observed by him, and some lee faces were excepted. It was also pointed out that the topography of the region was not classed by us with the rugged unsubdued type from which we inferred non-glaciation. On the contrary, we looked upon it as being partially subdued, and as indicating partial glaciation, a view which is precisely consonant with the determinations of Professor Tarr, and is substantially confirmed by them. Professor Tarr has thus unwittingly emphasized, by his attempt to place us in error, the fact that the difference between a wholly unsubdued and a slightly subdued topography can be detected by passing observers with no better facilities than a coasting vessel and good field glasses. When his photographs shall be published it will remain for glacial experts to determine whether the topography gives indication of the feeble glaciation that took place and was detected by us, or not, and whether experienced students of glacial topography can reasonably be expected to catch and correctly interpret such indications in passing or not. I predict with the utmost confidence that expert judgment will at once classify the topography studied by Professor Tarr precisely as Professor Salisbury and myself classified the topography of the general tract in which it is embraced. I feel confident that Professor Tarr will not be sustained in calling the topography of the upper Nugsuak peninsula unqualifiedly 'rugged' and 'angular,' but that, on the other hand, it will be pronounced partially subdued and obviously glaciated. I think it will then become evident that Professor Tarr's error lies, first, in a lack of sufficient care in interpreting our statements, and second, in identifying the feebly glaciated topography, which he studied, with our unsubdued topography, and in assuming that the topographic effects of glaciation cannot be detected even where some measure of ruggedness —even a large measure of ruggedness in the common gross sense of the term—may remain.

It was pointed out in the editorial that I recognized an extension of ice in the general region of Professor Tarr's studies essentially

equal to that which his observations imply, and that in this particular he has added to my determinations the confirmation of specific evidence.

T. C. CHAMBERLIN.

TWO EXTRAORDINARY BRITISH PATENTS.

PATENT No. 14,204, granted 27th October, 1884, by Her Majesty's Commissioner of Patents to Harry Fell, Mercantile Clerk, of South Norwood Park, is described as a 'New Method for getting Gold from Wheat.' The complete specification is as follows:

"That in the steeping of the mixture of half, measure, 'the whole wheat straw cut into fine square snips the width of the straw and half' the grains in a jar of ordinary cold water "I let the steep remain still for ten hours at a temperature of fifty-nine degrees Fahrenheit varying with temperature, and then straining off the liquor into a shallow pan of some such cool substance as china or earthenware, I leave this liquor to stand in this pan for yet twenty-four hours at sixty degrees also varying with temperature; these durations of times of ten hours and twenty-four hours speaking for a very inferior brown straw much knocked about and the grains those, of a very good quality, of red wheat; and then catch up the skim on a cylinder of some such cool substance as china or earthenware," and then let this skim dry, so getting some results of films of Gold."

The simplicity of this process for getting gold from wheat is as extraordinary as the language used in describing it; the above being a literal transcript, including the peculiar use of punctuation marks. The specification occupies two pages in quarto form and can be had at the Patent Office, Sale Branch, 38 Cursitor street, Chancery Lane, for two pence.

The second of these curious patents is numbered 1919 and bears the date 2d February, 1889. It is described as an 'improved means of detecting the presence of gold and silver underground,' and was granted to Samuel Adams Goodman, Jr., of Tyler, in the county of Smith and State of Texas, U. S. A. This specification also occupies two pages and is accompanied by a plate representing an ordinary glass bottle containing a solid body and a liquid, corked and sealed with wax; to the cork is fastened a string terminating in a loop.

Mr. Goodman, farmer, of Texas, makes the following statement:

"The object of this invention is to enable precious metals to be discovered by a process of divination; and it consists in a composition which has a strong attraction and affinity for gold and silver, the attraction resembling somewhat that of magnetism. In carrying my invention into practice, I place the composition in a vial or flask, seal it tightly and suspend it by means of a string. The composition referred to is made up of gold, silver, quicksilver and copper, the ingredients being placed in a small vial or flask, together with a quantity of dilute nitric, or tartaric acid or pure alcohol. * * *

"In using my gold and silver finder the instrument is held, preferably by the thumb and forefinger of the right hand and steadied with the left hand; it should be held steady but not cramped. Then, if there are any precious metals in the immediate neighborhood, the flask will be attracted by such metals and will move towards them at first and will then vibrate, thus indicating the presence of the metal sought for.

"To protect and conceal the contents of the flask, I cover it with paper, cloth or tin."

This is substantially the whole claim, in securing which Mr. Goodman was assisted by A. M. and Wm. Clark, patent agents of 53 Chancery Lane.

It is satisfactory to note that Texan farmers write English much more clearly than London mercantile clerks.

Western farmers are hereby warned against attempting to get gold out of their wheat by the Fell process and against seeking for precious metals by the Goodman method. But seriously why are patents granted to persons making such absurd claims?

H. CARRINGTON BOLTON.

COMPLIMENT OR PLAGIARISM.

THE following letter is sent for publication, at Mr. Lefevre's request, by Professor Beman.

MESSRS. BEMAN AND SMITH,

ANN ARBOR, MICHIGAN.

GENTLEMEN: I have just seen your reply to Dr. Halsted on page 275 of the current number of SCIENCE.

Much as I regret the unhappy chance that led to the furthest association of my name with that deplorable controversy—being a rational and just man—I do not reproach you, even for omitting to state the intrinsically trivial nature of the parallelism of that sentence in my book with a sentence in Sandeman's preface to his *Pelicotetics*. It was entirely proper to make

your point; but, considering the context, I am sorry you were not careful to prevent indefinite surmises by hasty readers. It may be remarked, also, that our librarian would gladly have furnished you still better proof that the book in question was in Texas.

It is my desire merely to explain that I wrote out the book hurriedly and partly from lecture notes made long before, and that the little rhetorical flourish (so acutely identified by you) somehow got incorporated without any consciousness, on my part, of its origin. If you will glance at the foot note on page 78 you will see that I was compelled once to quote: 'From note made long ago; exact reference lost.'

It only remains for me to correct the oversight so foreign to my principles and practice, and to have the *Errata* page changed at once so as to contain the following statement:

On page 92 read *single* quotation marks about the latter part of the last sentence of section 130 (after *accept*), and subjoin the foot note: An arraignment of algebraists on account of their abuses of infinite series, by A. Sandeman (*Pelicotetics*, 1868, Preface, p. 9.), which, though no longer deserved in that regard, is appropriate to widely prevailing ideas of the infinitesimal calculus."

It may be proper to add in conclusion that when I made the notes for my class lectures I had not the remotest intention of ever working up the matter for publication, and that this circumstance (though it would by no means excuse general carelessness) may explain how I accidentally omitted in this instance the citation for a rhetorical phrase that struck my fancy.

Yours respectfully,

Arthur Lefevre.

Austin, Texas, February 17, 1897.

REDUCED RATES OF POSTAGE ON SPECIMENS OF NATURAL HISTORY IN THE INTERNATIONAL MAILS—AN APPEAL.

Under the present regulations of the Universal Postal Union specimens of Natural History are admitted to the mails of the Union only at letter rates—five cents for each half-ounce or fraction thereof.

At the International Congress of Zoology, held at Leyden, Holland, in September, 1895, Dr. Chas. Wardell Stiles, official delegate of the United States government, offered resolutions, which were subsequently adopted, that the Swiss government be requested, through its delegate to the Congress of Zoology, to propose to the next International Postal Congress an amendment to the regulations thereof whereby specimens of natural history shall be carried in the mails of the Universal Postal Union at the rates for samples of merchandise; that an appeal should be addressed to all the delegates and members of the Congress of Zoology to bring this amendment to the notice of their respective governments, so that those governments should instruct their delegates to the Postal Congress to act favorably upon the same; that copies of these resolutions be sent by the Secretary of the Congress of Zoology to all governments forming part of the Universal Postal Union and which were not represented at the Congress of Zoology.

In accordance with these resolutions Dr. Stiles suggested to the Committee of the Academy of Natural Sciences of Philadelphia, having the subject of postage on natural history specimens in charge, that, although it is probable that the United States government will vote in favor of the proposed amendment, the cause will be helped by the Academy adopting resolutions in favor of this proposed amendment and requesting the Postmaster-General at Washington to instruct our American delegates to vote for the same.

This the Academy has done, but other American scientific bodies should join in the work, adopt similar resolutions and send them to our Postmaster-General that he may know that the students of natural history in the United States eagerly desire such a reduction in postage rates. The next International Postal Congress meets at Washington on the 5th of May next. The purpose of this article is to urge all those who read it to use such means and influence as may be at their command to help in the accomplishment of this end.

For the guidance of those who will aid in the manner suggested, a translation of the original French text of the amendment referred to is as follows:

"Amendment to Article XIX. (samples) 4, of the Regulations of Details and Order.

"5. Objects of natural history, dried or preserved animals and plants, geological specimens, etc., of which the transmission has no commercial interest, and the packing of which conforms to the general conditions concerning packages of samples of merchandise."

If this amendment be adopted by the Postal Congress, specimens of natural history can be sent to countries of the Universal Postal Union at the rate of one cent for every two ounces.

Statements of previous efforts of the Committee on behalf of the same object will be found in SCIENCE for November 17, 1893, p. 267, and for January 26, 1894, p. 49.

H. A. PILSBRY,
LEWIS WOOLMAN,
PHILIP P. CALVERT, *Chairman.*
Committee of the Academy of Natural Sciences of Philadelphia.

THE LAVOISIER MONUMENT.

FRENCH chemists, as well as physicists, are making an earnest effort to bring about the erection of a monument to perpetuate, in a measure, the memory of the great Lavoisier. They have authorized certain gentlemen in various countries to receive any contributions which non-residents of France may feel disposed to make in behalf of this very laudable undertaking.

The chemists of America fully recognize the services rendered their favorite science by the great French experimenter, and will doubtless be ready to add their mite to bring the proposed monument to an early completion. To facilitate matters the Academy of Sciences of Paris has appointed as its delegate in this country Professor Gustavus Hinrichs, who in turn has called to his aid the following gentlemen, to any one of whom subscriptions may be sent:

Jasper L. Beeson, A. M., Ph. D., Professor of Chemistry in the Audubon Sugar School, Research Chemist for the Louisiana Sugar Experiment Station, etc., New Orleans, Louisiana.

Charles Anthony Goessmann, Ph. D., LL. D., Professor of Chemistry at the Massachusetts Agricultural College, Chemist of the Hatch Experiment Station of the College; Chemist of the Massachusetts State Board of Agriculture, etc., Amherst, Massachusetts.

Eugene W. Hilgard, Ph. D., LL. D., Professor of Agricultural Chemistry in the University of California, Director of the California Experiment Station, Berkeley, California.

Richard Watson Jones, M. A., LL. D., Professor of Chemistry in the University of Mississippi, University, Mississippi.

John Uri Lloyd, Professor of Chemistry in the Eclectic Medical Institute of Cincinnati, President (1887) of the American Pharmaceutical Association, Cincinnati, Ohio.

John H. Long, M. S., Sc. D., Professor of Chemistry and Director of the Chemical Laboratories of the Schools of Medicine and Pharmacy of Northwestern University, 2421 Dearborn Street, Chicago, Illinois.

John Ulric Nef, Ph. D., Professor of Chemistry and Director of the Kent Chemical Laboratory of the University of Chicago, Chicago, Illinois.

James Marion Pickel, A. M., Ph. D., Professor of Chemistry in the University of Alabama, University, Alabama.

Paul Schweitzer, Ph. D., Professor of Agricultural Chemistry and Chemist to the Agricultural Experiment Station, University of the State of Missouri, Columbia, Missouri.

William Simon, Ph. D., M. D., Professor of Chemistry in the College of Physicians and Surgeons of Baltimore, in the Maryland College of Pharmacy and in the Baltimore College of Dental Surgery, 1348 Block Street, Baltimore, Maryland.

Edgar F. Smith, Ph. D., Professor of Chemistry of the University of Pennsylvania, Director of the John Harrison Laboratory of Chemistry; President (for 1895) of the American Chemical Society, Philadelphia, Pennsylvania.

Eugene Allen Smith, Ph. D., State Geologist of Alabama, formerly Professor of Chemistry, now of Mineralogy and Geology in the State University of Alabama, University, Alabama.

Henry Trimble, A. M., Ph. M., Professor of Analytical Chemistry in the Philadelphia College of Pharmacy, Editor of the American Journal of Pharmacy, 145 North Tenth Street, Philadelphia, Pennsylvania.

Francis Preston Venable, Ph. D., Professor of Chemistry in the University of North Carolina, Secretary (for 1896) of the Chemical Section of the American Association for the Advancement of Science, Chapel Hill, North Carolina.

Gustavus Detlef Hinrichs, M. D., LL. D., Professor of Chemistry St. Louis College of Pharmacy, Delegate of the Academy of Sciences of Paris, for the United States, 3132 Lafayette Avenue, St. Louis, Missouri.

Every subscriptien will be promptly acknowledged by a formal souvenir receipt, bearing the portrait of Lavoisier in prison. The original individual subscription papers will be bound and deposited in the Archives of the Academy.

While the American committee was rather late in beginning its work, we are advised that its efforts are slowly bearing fruit. Let every one who reads these lines join in the good work, giving money in accordance with his means and his regard for the conquests of the pioneer who wrought so well in laying the fundamentals of chemical science.

EDGAR F. SMITH.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC LITERATURE.

List of the Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London. London, Longmans, Green & Co. Ninth edition. 1896. Pp. xvi+724.

The preface to this work states that its principal object is to facilitate the naming of specimens and to render nomenclature uniform. It is merely a transcript of the Society's register of accessions illustrated by a few cuts from the proceedings. Its value would have been greatly increased had there been added statistics showing the number of each species present, the average life of each and the number and causes of the deaths. As the volume treats of all animals that have been in the garden during 12 years past, and embraces 2,557 species, a vast amount of information might thus have been given which would have been of great benefit not only to those having collections in charge, but to pathologists and biologists generally.

We are able to gather from the list some idea of the number and kinds of animals born in the gardens during this period and thus judge how far the conditions were favorable for breeding. Some rather unexpected results are met with. We will consider the mammals only. The lemurs breed much more freely than monkeys; the lion is the only one of the cat tribe that is prolific, though our own puma is credited with five births. Among Esquimaux dogs there were but 9 births; the dingo has 15. From an apparently large number of raccoons but 8 were born, and among 52 squirrels (*Sciurus vulgaris*, common to the British islands) there were no births. On the other hand 14 beaver (*Castor canadensis*), 6 bison (*B. americanus*), 19 American elk, or Wapiti (*Cervus canadensis*), 35 mule deer (*Cariacus macrotis*) were born. The South African fruit bats (*Cynonycteris collaris*) produced 44, and the gerbilles, rat-like animals from western Asia and North Africa, threatened to become a nuisance, the birth of no less than 225 being recorded. Other notable births were 47 coypus, 13 yaks, 11 gayals (*Bibos frontalis*), 18 Himalayan sheep (*Ovis burrhel*) 15 Barbary sheep (*Ovis tragelaphus*), 43 Japanese deer (*Cervus sika*), many kangaroos and phalangers.

Certain species that breed freely in American zoological collections appear not to have bred at all or but rarely. Among these may be mentioned our coyote, prairie dog and chipping squirrel (*Tamias striatus*) the collared peccary, the Virginia deer, and even some domesticated animals like the camel, the llama and the zebu. Some of these results could doubtless be explained were the circumstances of each case fully known.

FRANK BAKER.

SMITHSONIAN INSTITUTION.

Genius and Degeneration. A Psychological Study. By DR. WILLIAM HIRSCH. D. Appleton & Co. 1896.

This work is published in the same style type as Nordau's 'Degeneration' and is announced as an answer to the latter work. An accompanying circular assures us that Dr. Hirsch 'absolutely refuses to accept Dr. Nordau's conclusions.' This at once removes a good deal of tension from the inquiring critic and leaves him the simpler tasks of finding out who it is that thus deals in the absolute and what are his reasons for so firm an implantation of himself upon an adverse position. The opening chapters of the book discuss the position of modern psychiatry and the nature of insanity and of genius. It is shown that neither of these latter things represents a very definite psychological concept. The author then takes up the relations of genius and insanity to each other. He shows that they are not identical and that "genius resembles insanity as gold resembles

brass''—a similie that can hardly be called convincing. In this chapter he also attacks the position of Lombroso and those few alienists who teach that genius is a morbid psychosis. We feel sure that Dr. Hirsch is in close harmony with the views of most modern alienists in this argument, and that he opens himself to no criticism, except, perhaps that he tells us only what is generally known; but Dr. Hirsch writes lucidly and with learning upon this subject. In his criticism on the attempts to make out a large number of great men epileptics or hallucinants, we note a little deficiency in his description of Luther's historical hallucination about the devil. The completed story leaves little doubt that Luther did have such a hallucination, though the fact is not very significant or important. The next chapter, on 'degeneration,' is an excellent description of this condition and so much in harmony with the views of Nordau that we are left wondering where the antagonism between the author and the Nordau monster is to appear. Up to the middle of the book, in fact, the two authors might coo together like turtle doves. It is in the last three chapters on 'Secular Hysteria,' 'Art and Insanity,' 'Richard Wagner and Psychopathology,' that we find Dr. Hirsch tasking his resources and his rhetoric in showing the errors and extravagances of his opponent. These chapters are interesting, but are essentially polemical and do not have any particular bearing on Genius and Insanity—a fact which does not matter very much except in marring the scientific physiognomy of the book. Dr. Hirsch denies that this is an age of hysteria and of neuropathic temperaments. Unfortunately he does not furnish any particular facts in support of his denial. He says, "spiritualism has in the main died out," but this is not the case in the United States at least. He cites the epidemics of hysteria of the Middle Ages as evidence of psychopathy in those times; but their existence, it may be fairly assumed, was not by any means proof of a prevalent neuropathy as much as it was of ignorance, religious zeal and church politics. No doubt very sturdy and lethargic natures danced with the rest of the populace in the epidemics of those times and did it out of a healthy fright, or puerile imitativeness or ignorant passion. The existence of false beliefs among an untutored race does not argue degeneracy by any means. The question at issue is in reality simply this: Whether there are or are not more neuropathic people per hundred of the population now than a century or two centuries ago. We confess to the opinion that there is now more of this neuropathic constitution. The statistics of crime, alcoholism, insanity and nervous diseases; the fact that a larger proportion of the population are brain workers living on a higher mental plain than in former times; the diffusion of syphilis, the stimulating influences of modern civilization, the press, the telegraph, the railroad; the gradual increase of urban at the expense of rural populations, all justify this position, which I believe only a blind or sentimental optimism can deny. This does not necessarily mean, however, that we are 'in the midst of a black death of degeneracy and hysteria,' but only that there we have now proportionately more nervous systems which are highly organized and unstable. We doubt if even Dr. Hirsch will deny this, and it is mainly the exaggerated and intense emphasis laid upon the matter by Nordau which has brought out such a crop of amateur optimists. We are, I should add, combating this condition with ever increasing diligence and, I trust, success.

There seems to be little doubt that a man may be insane and still produce art of a high, if not of the highest quality. Here is where an endless controversy, however, is let in. For one party asserts that certain art work is of the highest class, hence the author is not insane. The other, with equal positiveness, avers that the man is insane, hence his work can not be of the highest class. I do not propose to be dropped into this controversial cauldron. It is, I believe, however, a pretty safe thesis to say that if a man is insane his work cannot be of the highest class or rank with that of a genius, since the fundamental quality of insanity is a more or less completely developed dementia, and a certain positive defect in the association processes. This has not prevented men of genius, originally sane, from doing some kinds of great work after mental disease had come upon them, through the sheer inertia of their marvelous aptitudes.

Dr. Hirsch devotes nearly one-third of his book to the defense of Richard Wagner. He must have felt that his hero was hard pressed. The great majority of his readers will, no doubt, believe that he has maintained his thesis and established his hero on a sane and solid basis. We are not at all unwilling to accept his position. But it is an interesting fact that the Wagner vogue, aside from Germany, has reached its greatest popularity in this country, a land which has, with equal fervor, taken to its heart spiritualism, homœopathy, Christian science and free coinage. Dr. Hirsch has, in general, reasoned well and shown both the learning of an alienist and the scholarship of a literateur. But we are grieved to see him descend to thecheap sophism that Nordau, by his own rules, has shown himself a degenerate. This brilliant touch has been applied before by three-fourths of the penny-a-liners who have attacked his work. While it may be suggested by Nordau's extravagant invective, it is simply not a logical retort. For it makes no difference what the author of an argument is. It is the force of the facts upon which it is based that concerns the critic.

Charles L. Dana.

New York.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

The March number opens with an article by J. S. Diller, of the United States Geological Survey, describing Crater Lake, in southern Oregon. This lake is situated in the summit of the Cascade Range, and, notwithstanding the interest of its geological history and the beauty of the natural scenery, a comparatively small part of the scientific public is acquainted with its features. The nearly circular rim of the lake has an average diameter of six miles and rises 1,000 feet above the general level of the range. The slope without is gentle, but within quite precipitous. The general appearance is that of the hollow base of a large and deeply truncated cone, filled within by the waters of the lake. The crest of the rim varies in height from 6,700 to 8,200 feet above the sea, or from a little more than 500 to nearly 2,000 feet above the waters of the lake. The rim is composed of lava streams and beds of volcanic conglomerate, which dip away from the lake. The prevailing rock is andesite, but rhyolites are common along the later flows and these are largely associated with pumice. A number of vertical dikes intersect the rim, the largest of which is known as the Devil's Backbone. Within the lake is an island called Wizard's Island, which consists of a steep cinder cone 845 feet in height, surmounted by a perfect crater 80 feet in depth and encircled by a rough lava field. According to soundings taken by Dutton in 1886, other prominences of this kind exist at the bottom of the pit. The rim of the lake has been extensively glaciated, and the study of the glacial striæ and moraines gives evidence of the changes which have taken place since the glacial period.

After discussing the prominent features of the locality, some of which are here alluded to, the author concludes that in the glacial period the site of Crater Lake was occupied by an active volcano about the height of Mt. Shasta; this has been called Mt. Mazama. Its sides were glaciated by the descending ice streams, and moraines were deposited about its base. The author concludes as follows:

"The later eruptions of Mt. Mazama occurred in the glacial period and doubtless produced extensive floods which filled with débris the valleys of all the streams radiating from the mountain. In approximate connection with its final eruption, the molten material of the interior withdrawing, the summit of Mt. Mazama caved in and sank away, giving rise to a caldera nearly six miles in diameter and 4,000 feet deep. Thus originated the great pit in which Crater Lake is contained, encircled by a glaciated rim, the hollow base of the engulfed Mt. Mazama. Upon the bottom of the caldera volcanic activity continued. There were new eruptions building up cinder cones and lava fields and partially refilling the great pit. Precipitation is greater than evaporation in that region. Volcanic activity ceasing, the conditions were favorable for water accumulation, and Crater Lake was formed in the pit."

F. D. Adams and A. E. Barlow discuss the origin and relations of the Grenville and Hastings series in the Canadian Laurentian. This is in continuation of an earlier paper by the

first author on the same general subject. The region now especially described lies to the north of Lake Ontario, along the margin of the Protaxis. The nature of the various igneous rocks which make up the Fundamental Gneiss is described, and then the Grenville series, differing from the former in containing certain rocks whose composition marks them as highly altered sediments, for example, limestone and certain gneisses, either having a composition approaching ordinary shale and slate or highly siliceous, and thus corresponding to sandstones. The whole has been invaded by great masses of the so-called Fundamental Gneiss. The southeastern portion of the area is underlain by the Hastings series, characterized particularly by fine-grained bluish or grayish limestones and dolomites, differing from those of the Grenville series in being comparatively unaltered; these are cut through by intrusions of gabbro-diorite and granite. The contact of the Fundamental Gneiss and the Grenville series appear to a contact of intrusion; further, as regards the relation of the two series to each other, observations thus far made indicate that the Hastings series represents the Grenville in a less altered form. That is, "the Hastings series, when invaded, disintegrated, fretted away and intensely metamorphosed by and mixed up with the underlying magma of the Fundamental Gneiss, constitutes what has elsewhere been termed the Grenville series." "Like the Grenville series, the rocks of the Hastings series are unconformably overlain by and disappear beneath the flat-lying Cambro-Silurian rocks of the plains, which limit the Protaxis on the south and are separated from it in time by an immense erosion interval." The authors add that if the explanation reached is correct, the Laurentian system of Logan will resolve itself into an enormous area of the Fundamental Gneiss, which is essentially of igneous origin and which there is every reason to believe forms part of the downward extension of the original crust of our planet, perhaps many times remelted and certainly in many places penetrated by enormous intrusions of later date; into which Fundamental Gneiss, when in a softened condition, there have sunk portions of an overlying series, consisting chiefly of limestones.

The paper closes with some remarks by R. W. Ells, describing observations made by him in the region adjoining to the east, which confirm and extend the conclusions of the other authors named.

C. E. Beecher gives (pp. 181–207) the conclusion of his exhaustive paper on tl e Natural Classification of the Trilobites, closing with an index list of the genera included. F. B. Taylor describes the various forms of scoured bowlders in the Mattawa Valley, in the Province of Ontario. A number of distinct varieties of the bowlders are recognized; as those reduced to a ring form, others with a basin-like hollow, and finally those which are faceted or simply smoothed. The special conditions under which each type was probably produced are discussed at length, and it is shown that the evidence is very strong in favor of the supposition of a former outlet of the Upper Great Lakes along the present course of the Mattawa River.

C. Barus discusses some observations on the excursions of the diaphragm of a telephone made with the special interference apparatus described in the February number. It is concluded, for example, that in the case of telephonic sounds of faint but distinct audibility the excursions of the plate cannot be greater than 3×10^{-6} cm., and are probably even below 10^{-6} cm. A computation of the force coming upon the plate in certain cases gives 141 dynes as the force at the center. R. S. Tarr describes the action of Arctic sea ice in geological work; from observations made at various points in the high north. The nature of sea ice and glacial ice is spoken of, the influence of sea-made ice on erosion, further the erosion by glacial ice, and the transportation accomplished by both kinds.

W. O. Crosby gives the results of his study of the geology of Newport Neck and Conanicut Island, especially with reference to the relation existing between the granite and the sedimentary rocks. The latter consist in part of Carboniferous slates, in part of flinty slate, which resembles the Middle Cambrian slates of the Boston Basin. The author does not accept the view of Pirsson, that the flinty slate grades into the highly fissile Carboniferous slates, but re-

gards his observation as proving that the two formations are distinct. The arkose which forms a continuous belt separating the flinty slate and the unaltered green shales is believed to be a regular member of the Carboniferous series. F. A. Gooch discusses the use of hydriodic acid in the estimation of molybdenum. This subject was treated in 1806, by Goosh and Fairbanks, but their methods were criticised by Friedheim. The present article shows that certain errors of calculation in an earlier paper by Friedheim and Euler vitiate the conclusions reached in the criticism referred to. I. C. Russell gives an abstract of the results of recent observations in southeastern Washington, especially as regards the immense lava fields of the region and the gorge formed through them by the Snake river; this is said to rival the Grand Canyon of the Colorado in grandeur, though lacking its brilliant coloring.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE Philosophical Society of Washington held its 464th meeting on the 20th inst, at which E. D. Preston, of the United States Coast and Geodetic Survey, read a paper on 'The Transcontintental Arc from Cape May to San Francisco,' which was followed by a paper by Wm. Eimbeck, of the same Survey, on 'The New Primary Base Apparatus,' used by the Survey, illustrated by one of the bars mounted. Mr. J. Howard Gore read a paper on 'A Dutch Practical Charity,' and Charles R. Dodge read a paper on 'Systematic Classification of Textile and other useful Fibers of the World,' illustrated by samples.

BERNARD R. GREEN,
Secretary.

SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN, JANUARY 18, 1897.

THE subject, 'Modern Methods of Milk Preservation,' was presented by Professor H. L. Russell. He divided the different methods proposed into three classes: 1. Those excluding bacteria from the milk; 2, those inhibiting the development of bacteria as in condensed or preserved milk, or where milk is kept at temperatures too low for bacterial growth; and 3, those in which bacteria are actually destroyed, as in the various methods where heat is employed, as in pasteurization and sterlization. He also discussed the new method, devised by Dr. Babcock and himself, of restoring the consistency to pasteurized milk products. Mr. Louis Kahlenberg, in his paper, 'The Toxic Action of Dissolved Salts and their Electrolytic Dissociation,' gave, as an introduction, a brief explanation of the theory of electrolytic dissociation and the reasons for holding the same. The general proposition was made that the physiological action of a solution of an electrolyte depends on the action of the undissociated molecules, together with that of the ions present. The results of many experiments upon plants performed by the author and Mr. R. H. True and Mr. F. D. Heald were cited to substantiate this view. It was further pointed out that experiments on bacteria performed at the University, and recent investigations carried on at the University of Leipzig, further confirm the general proposition which was first published in the *Botanical Gazette* of August, 1896, by Kahlenberg and True. The significance of the discovery to physiological chemistry, agriculture, bacteriology and therapeutics was briefly mentioned.

WM. S. MARSHALL,
Secretary.

NEW BOOKS.

A Treatise on Analytical Statics. EDWARD JOHN ROUTH. Cambridge University Press. New York, The Macmillan Company. 1896, 1892. Vol. I. Pp. xii+301. Vol. II. Pp. xii+224.

Elementary Text-book of Physics. WM. A. ANTHONY and CYRUS F. BRACKETT. Revised by W. F. MAGIE. 8th edition. New York, John Wiley & Sons. London, Chapman & Hall, Ltd. 1897. Pp. viii+512. $4.00.

Researches upon the Antiquity of Man. HENRY C. MERCER. Boston, Ginn & Co. 1897. Pp. 178.

Die Chemie in täglichen Leben. DR. LASSAR-COHN. Hamburg and Leipzig, Leopold Voss, 1807. 2d edition. Pp. vii+303. 4 M.

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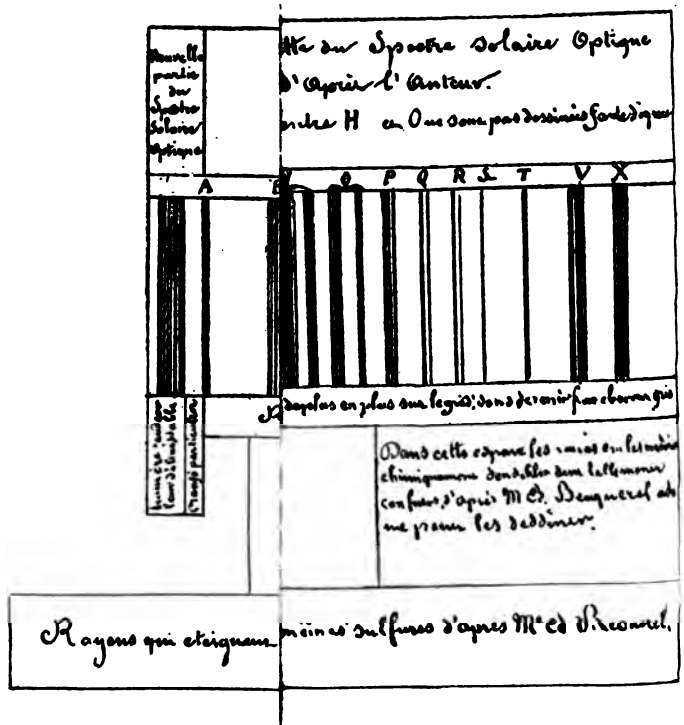

SCIENCE

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FRIDAY, MARCH 12, 1897.

CONTENTS:

A Lecture by Regnault: WOLCOTT GIBBS 409
Professor Fontaine and Dr. Newberry on the Age of the Potomac Formation: LESTER F. WARD 411
The American Morphological Society: G. H. PARKER.....423
Current Notes on Physiography:—
Campbell on Drainage Modifications; Russell's Glaciers of North America; The Gohna Landslip: W. M. DAVIS 437
Current Notes on Anthropology:—
The Amerique Indians; 30th Report of the Peabody Institute; Pliocene Man in Britain: D. G. BRINTON.....438
Notes on Inorganic Chemistry: J. L. H.....439
Scientific Notes and News:—
Revue de Méchanique; General.....440
University and Educational News.....444
Discussion and Correspondence:—
Opportunities for Training in Physiology: H. P. BOWDITCH. *Note on Natrix Grohamii* B. & G.: FRANK C. BAKER, FRANK M. WOODRUFF. *Pseudo-Aurora Again:* H. A. HAZEN. *Greenland Glaciers:* EDWARD H. WILLIAMS, JR.....446
Scientific Literature:—
Letourneau on l'Evolution de l'Esclavage: D. G. BRINTON. *The Geological and Natural History Survey of Minnesota:* C. E. BEECHER. *Shaw on Municipal Government in Continental Europe:* EDWIN O. JORDAN 448
Societies and Academies:—
Torrey Botanical Club: EDWARD S. BURGESS. *The New York Academy of Sciences:* W. HALLOCK. *The Academy of Science of St. Louis:* WM. TRELEASE.....451

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A LECTURE BY REGNAULT.

WHEN a student at the Collége de France in 1847 I heard a lecture by Victor Regnault, of a part of which I send a copy. So far as I know, it was never printed. The lithographed copies were paid for by the students themselves. I think that the figures of prisms given (see plate) will have something more than a purely historical interest even now.

WOLCOTT GIBBS.

NEWPORT, January 27, 1897.

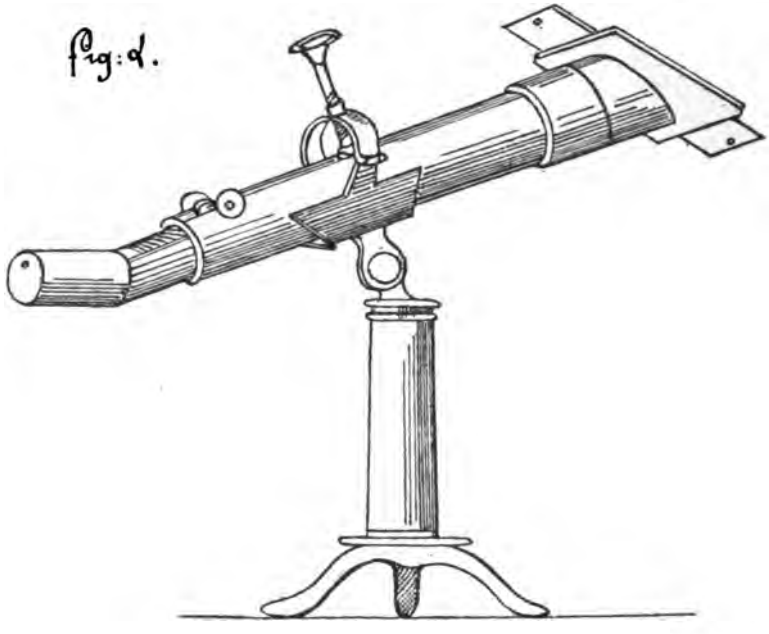
Quelques physiciens ont construits des appareils au moyen desquels on peut observer les raies du spectre sans qu'il soit necessaire de se placer dans une chambre obscure.

A l'une des extrémités d'un tuyau, Mr. Dujardin place un diaphragme rectiligne; à l'autre extrémité, un certain nombre de prismes fixés dans la position du minimum de déviation, en les disposant ainsi, il a pour but de diminuer autant que cela est possible, l'aberration de sphéricité qui résulterait de ce que les rayons incidents ne sont pas paralléles.

On obtient ainsi un spectre très dévié, mais cette disposition présente plusieurs inconvénients; la déviation minimum n'a lieu que pour les rayons qui marchent dans l'axe du tuyau; de plus, quoi que l'on ait diminué le plus possible l'épaisseur des prismes les pertes de lumière par réflexion

sur leurs faces, sont encore assez considérables.

Mr. Mathiessen a fait disparaître ces inconvénients au moyen de l' appareil qui est représenté par la figure (*a*).



Il se compose essentiellement d 'un lentiprisme (Fig. B.), c'est-à-dire d 'un prisme dont une des faces est lenticulaire. Cette face est perpendiculaire à l'axe d 'un tuyau qui porte le prisme à l 'une de ses extrémités et qui est réuni à l'autre bout d'un diaphragme rectiligne. Les rayons lumineux en traversant la face lenticulaire sont ramenés au parallélisme et arrivent à la face postérieure en faisant tous un angle à peu près égal à celui de la réflexion totale. Ils emergent par consequent presque parallèles à cette seconde place. L'effet du lentiprisme ressort des figures A. B. C. dessinées par Mr. Mathiessen. La fig. A. montre comment un prisme ordinaire qui reçoit un faisceau de rayons non parallèles et qui est placé dans la position du minimum de déviation par rapport aux rayons centraux, produit encore une aberration de sphèricité considérable, parcequ'il ne remplit pas la même condition à l'égard de tous les rayons. Grâce à la face lenticulaire du lentiprisme B, qui rend les rayons parallèles avant leur arrivée à la face de sortie, l'aberration de sphèricité se trouve évitée; il ne reste que l'aberration de réfrangibilité qui importe peu, parcequ'il n'est pas nécessaire d'observer toutes les couleurs en un même point. Le système C, composé d'une lentille et d'un prisme pourrait produire un effet analogue à celui du lentiprisme mais pour produire la même dispersion sur un faisceau incident de même ampleur, il devrait avoir une masse beaucoup plus considérable. On peut encore empêcher l'aberration de refrangibilité par l'addition de lentilles disposées de façon à produire une sorte d'achromatisme.

Cette modification se trouve réalisée dans les figures F et G, qui représentent, en outre le lentiprisme composé. Ce lentiprisme composé a permis à Mr. Mathiessen d'obtenir une dispersion plus considérable qu'avec le prisme simple. Et c'est ainsi qu'il a pu

étendre les parties extrèmes du spectre au delà des limites observées par Fraunhofer. Les nouvelles parties du spectre, avec leur raies sont représentées dans la Fig. 4, qui est la reproduction du dessin communiqué par Mr. Mathiessen.

PROFESSOR FONTAINE AND DR. NEWBERRY ON THE AGE OF THE POTOMAC FORMATION.

THE appearance at this time of two important works on the Potomac formation, though both of them have been long delayed in publication, is peculiarly opportune in view of the discussion now going on in relation to the age of that formation. These works are first, that by Professor Fontaine on the Potomac Formation in Virginia,* and second, that of Dr. J. S. Newberry, on The Flora of the Amboy Clays.†

The greater part of the matter of the first of these works was originally submitted by Professor Fontaine as an introduction to his important work on The Flora of the Potomac Formation,‡ giving a somewhat detailed account of the stratigraphical relations of the Potomac formation in Virginia. But it was thought best to omit this introductory part and publish it separately. Owing to causes which need not be here enumerated, the publication of this part of his work was long neglected, but is now hapily before the scientific world.

As its name implies, this treatise is confined mainly to those portions of the Potomac formation which lie south of the Potomac River, *i. e.*, almost exclusively to the State of Virginia, and only contains incidental references to the condition of things in Maryland. A consequence of this is that it deals wholly with the Older Potomac and does not attempt to discuss the prolongation of the formation through New Jersey and northeastward, where all the beds thus far found belong to the Newer Potomac, which finds its greatest exemplification in the Raritan and Amboy Clays.

The second of these works, on the contrary, deals exclusively with the Newer Potomac, but under the term Amboy Clays Dr. Newberry expressly included all that was known to him of those beds which occupy the north shore of Long Island and are found all the way from Staten Island to Marthas Vineyard. Although I have designated these latter beds as the Island Series, and have sufficiently demonstrated the justness of this subdivision, I have at the same time admitted that the character of the flora is substantially the same throughout.

We thus have two new contributions to the subject under discussion written by able men who are not exclusively nor chiefly paleobotanists, but are known to the world as geologists of the first grade, each of whom prior to writing his work had devoted many years to an exhaustive study of the formation to be dealt with. Although much has been learned since the date at which these works were written, it is not proposed in this paper to make special reference to such discoveries, as they have been for the most part fully set forth in a series of papers by Mr. David White, Dr. Arthur Hollick and myself, an acquaintance with which will be assumed on the part of the reader.* But

* The Potomac Formation in Virginia, by William Morris Fontaine, Bull. U. S. Geol. Surv., No. 145, Washington, 1896.

† The flora of the Amboy Clays, by John Strong Newberry. A posthumous work, edited by Arthur Hollick. Monographs of the U. S. Geological Survey, Vol. XXVI., Washington, 1896 (erroneously dated 1895).

‡ The Potomac or Younger Mesozoic Flora, 2 Vols. text and plates. Monographs of the U. S. Geological Survey, Vol. XV., Washington, 1889.

* See Bull. Geol. Soc. Am., Vol. I., p. 554; Vol. VII., p. 12; Am. Journ. Sci., 3d Ser., Vol. XXXIX., p. 93; Trans. N. Y. Acad. Sci., Vol. XI., p. 96; Vol. XII., p. 1, 222; Vol. XIII., p. 122; Bull. Torr. Bot. Club, Vol. XXI., p. 49; Fifteenth Ann. Rept. U. S. Geol. Surv., p. 307; Sixteenth Ann. Rept. U. S. Geol. Surv., p. 463.

the treatises here mentioned give the matured views of their authors, and in the case of Dr. Newberry this work constitutes almost his last contribution to science. I would therefore ask the privilege of directing the attention of those geologists who are interested in the discussion of the age of the Potomac formation to the opinions of these two authors, and I have no apology to make for quoting somewhat freely from them. I will also take the liberty of italicizing, on my own responsibility, those passages which I regard as bearing most directly upon the subject.

When Professor Fontaine commenced his studies he was confronted by the views of Professor Rogers, who, although he had recognized the clear distinction between the Triassic formation and the higher Mesozoic beds and had designated the former as 'Jura-Trias' and the latter as 'Jurasso-Cretaceous,' inclined to regard the whole as belonging below the Cretaceous. It therefore required paleontological evidence to settle the question. Some fossil plants had been found in the Trias which were determined by Bunbury, but, on account of the imperfect material and of the little that was then known of the Mesozoic floras, he was disposed to regard them as indicating an age similar to that of the Oolite of Yorkshire. This view had been completely disproved by Professor Fontaine's previous studies of 'The Older Mesozoic,' as embodied in his work on that flora,* and he had correlated it with those transition beds in Europe and other countries which lie on the border of the Triassic and Jurassic and are known as Rhetic. Since that work was published Stur discovered at Lunz, in Austria, a flora which corresponds still more closely with that of America, even containing a number of the same species, the beds yielding it having been definitely fixed in the Upper Keuper, and we may now look upon this as the more correct correlation.* After giving an account of the manner in which the fossil plants of the Younger Mesozoic were discovered and of their general character Professor Fontaine says (p. 14): "None of these fossils have been found in the Richmond coal field, and, so far as known, *none of the supposed older Mesozoic areas contain any of them.* It is sufficient to say here that this flora indicates that the Potomac beds were laid down in a period *decidedly more recent* than that in which the middle secondary strata of Rogers were deposited." Again, on p. 142, referring to the same subject, he says:

"In Virginia the youngest formation upon which the lower, or sandy member of the Potomac is seen to rest, is the older Mesozoic or Rhetic formation. The interval of time, however, between the deposition of the Rhetic and the deposition of the Potomac beds must have been a considerable one. There are several reasons for coming to this conclusion: (1) Where the superposition of the Potomac on the Rhetic is visible the latter is seen to have been greatly worn before the deposition of the former. (2) The lithologic and structural character of the two formations is very different, implying a total change in the conditions of deposition. (3) The Rhetic is made up of sandstones and shales which are distinctly bedded, so that the dip and strike can be easily made out. The materials composing these beds were well sorted by water action. Before the deposition of the Potomac the Rhetic strata had been consolidated and, in the main, indurated, so as to form firm sandstones and shales, or even slates. The Rhetic beds are in many places crushed, contorted, and faulted, all of which changes took place before the Potomac age. No traces of them

*The Older Mesozoic Flora of Virginia. Monographs of the U. S. Geological Survey, Vol. VI., Washington, 1883.

*Cf. Bull. Geol. Soc. Am., Vol. III., p. 31.

are found in the Potomac. The Rhetic is also penetrated by numerous dikes of igneous rock, none of which pass into the Potomac beds. The interval of time separating the two formations must, then, have been long enough to permit the occurrence of important geologic changes. These resulted in the draining off of the Rhetic waters and in the lateral compression of the Rhetic areas, which caused crumpling and faulting of the strata and outpours of igneous rock. The Rhetic basins were elevated and formed into dry land, subjected to great erosion, and the most eastern of them then depressed and brought under water again. *Certainly no Rhetic species of plant survives into the Potomac.*"

From all this it is apparent that the Older Mesozoic or Triassic formation of the Atlantic border has really nothing to do with the Potomac formation. Only in a few places, as through parts of New Jersey and in Virginia for a short distance in the vicinity of the North Anna and South Anna Rivers, are the two formations in contact, and here the latter rests in complete unconformity upon the former. At all other points they are separated by an interval of greater or less width of the old crystalline rocks. This shows that the Trias, as well below the Hudson as in the Connecticut Valley, constitutes a trough and forms no part of the Coastal Plain proper, having its affinity much more closely with the Piedmont Plateau. The fact that not a single Triassic species passes up into the base of the Potomac further proves that that interval must have been an exceedingly long one, and it is quite in conformity with the facts to suppose that it embraced the entire Jurassic period.

The little that Professor Fontaine has to say of the relations of the Virginia beds to those of Maryland and farther north is important and shows that, although he had not studied the latter except in a general way in Maryland, he had nevertheless formed a tolerably accurate opinion as to their nature. On page 14 he says:

"It should be stated that there is reason to think that the extensive formation of clay and fine sand known in Maryland as the 'variegated clay formation,' or the 'iron-ore clays,' may belong to the same general epoch as the Potomac of Virginia, forming an upper member of the group of which the Virginia Potomac is the lower. The Virginia beds and those of Maryland cannot now be certainly separated by any sharp differences; hence, for the present, the Virginia strata must be regarded as Lower Potomac, and the Maryland formation as Upper Potomac." And, again, on page 142 he makes the following statement:

"On entering the District of Columbia two members of the Potomac formation may be recognized. The lower is that traced through Virginia, and this is the only member recognized in that State. From the predominance of sand and sandstone in this it may be called the sandy member. The other, or upper member is composed of sands and clays, mostly the latter, both being usually highly colored with tints due to oxide of iron. The clays greatly predominate. They have the colors arranged in irregular spots, patches, and seams, and on account of this they have been called by Mr. Philip Tyson and Professor Rogers the variegated clay group. This is the upper member of the Potomac described at Fort Washington.

"*The sandy lower member of the Potomac is visible at Washington and at several points between Washington and Baltimore, in the vicinity of the Baltimore and Ohio Railroad.* The farthest point north at which it has as yet been seen is Baltimore."

It is clear from this that Professor Fontaine believed that the Older Potomac existed in Maryland. I remember his saying to me at about the time that I began my

studies of the formation in that State that he thought the cycads came from the sandstone member, and he once took me to see what he regarded as a typical exposure, on the Patapsco, near Relay, of the basal arkose, identical with certain phases that it presents in Virginia. This observation has been abundantly verified.

In common, however, with the prevailing opinion at that date, which was shared by Mr. McGee and myself, he regarded the iron ore clays, so-called, as somewhat higher and as constituting an 'Upper Clay Member.' At that time no other fossils than cycads, silicified wood and lignite had been found in the iron ore belt. Within the last two years, however, Mr. Arthur Bibbins has demonstrated the occurrence of fossil plants representing a considerable variety, but chiefly consisting of ferns and conifers. He finds them not only in the iron ore deposits, but in the iron ore itself, and I have had the satisfaction, in company with him, of collecting a large number of these and also of examining the much larger collection which he has made. Although these collections have not yet been elaborated and fully determined, a simple glance at them would be sufficient to show that they represent a flora substantially identical with that of the basal Potomac in Virginia, as typified in the Fredericksburg deposits. At the same time that Mr. Hatcher collected the bones in these beds which were described by Professor Marsh, and which constitute the only paleontological evidence that he has thus far brought forward as to their age, he also obtained, in intimate association with the vertebrate remains, a large number of fossil cones, which belong to the genus Sequoia and were undoubtedly borne on the trees which have furnished the silicified wood. All this is simply confirmatory of the antiquity of the iron ores and of their substantial identity in age with the basal Potomac of Virginia.

Professor Fontaine's general conclusions as to the stratigraphical relations of the Potomac formation are of such value in connection with the views of Dr. Newberry, next to be considered, that they should be given somewhat *in extenso*. They are to be found on pages 143–147 of this Bulletin:

"The New Jersey beds, as is shown by their fossil plants, *are certainly considerably younger* than the Virginia member of the Potomac. So far as is yet known, the Amboy clay is not younger than the Cenomanian of Europe.

"So far, then, as can be determined by the stratigraphy, the Virginia Potomac is considerably older than the Cenomanian and *much younger than the Rhetic.* The evidence from the stratigraphy, so far as it goes, agrees well with that of the fossils found in the Potomac.

"*The Wealden formation is most probably not uppermost Jurassic, but the estuary and marsh equivalent of the oldest marine Neocomian.* What will be said therefore concerning the Neocomian will include the Wealden.

"The flora of the Potomac seems to have been an abundant one. It was rich in species of certain groups, but, as compared with modern floras, it was poor in types. A large amount of fossiliferous material was obtained from points located at intervals between James River and Baltimore. The fossils found will give a fair idea of the general character of the flora. This flora has been studied by me, and is described in Monograph XV of the United States Geological Survey. The comparison of these plants with those of known fossil floras shows somewhat complex relations.

"There is present in the Potomac flora *a Jurassic element* which is large in the very considerable number of *genera* that characterize that system. Some few of the *genera* begin as far back as the Rhetic. This element shows indications of decadence. The number of species of each genus is

very small; generally only one or two. Very few individuals of the species are met with, and they are usually local in occurrence. The species are nearly or quite all peculiar to the Potomac.

"There is an important *Wealden element* in the flora. Many *species* of Potomac plants *are identical with species found in the Wealden of Europe, and this is the oldest known fossil flora that gives any considerable number of plants identical with the Potomac species.* Some of these species of the European Wealden are abundant and widely diffused plants in the Potomac. But while the species common to the European Wealden and the Potomac are noteworthy, there is a still larger number of important species found in the Potomac which are so nearly allied to Wealden species that they are with difficulty distinguished from them. These, although regarded as new species peculiar to the Potomac, *are probably forms representing Wealden species*, being modified by differences of environment.

"The Jurassic and the Wealden elements combine to give a Jurassic or Mesozoic facies to the flora, and hence, so far as they go, give it a comparatively ancient character. The Jurassic or Mesozoic type of flora is, as is known, characterized by the overwhelming predominance of four elements, viz: Equiseta, ferns, cycads, and conifers, and by the absence of angiosperms.*

"*The formations which possess the largest number of species identical with those of the Potomac are those of the Middle Neocomian or Urgonian.* The strata of this age which occur in Greenland (in Kome and other localities) and the Wernsdorf beds of the northern Carpathians yield an Urgonian flora, which Heer and Schenk have described. *In the plants coming from these regions we find the largest number of forms identical with Potomac species.* The number of Potomac species nearly allied to Urgonian forms is still larger. These identical and nearly allied species include many of the most characteristic, abundant, and widely diffused species of the Potomac. If we are to determine the age by the largest number of important species identical with those of known fossil floras, then *we would without hesitation set it down as ranging from the Lower through the Middle Neocomian.* A very large and important element of the Potomac flora is peculiar to this series. In this we find without doubt the most abundant, characteristic, and widely diffused species. As these are new, they can not give any direct evidence concerning the age of the formation, but indirectly the existence of such a large proportion of peculiar forms is favorable to the assumption that the age is Neocomian. The flora of this formation is one of the least known, and any large collection of richly fossiliferous material from beds of Neocomian age could not fail to furnish a great number of new species.

"Then again, the relatively great development of the conifers, along with the existence of an important cycadaceous element, *points strongly to the Neocomian as the era of the formation.* The survival of a considerable Jurassic element in the flora also indicates that it can hardly be younger than Neocomian. While much the most important elements of the flora indicate an age not more recent than the Urgonian or Middle Neocomian, there are some species which point to a more recent era of deposition for the formation. There are one or two species which are probably identical with forms found by Heer in the Cenomanian beds of Greenland. These are local and are represented by very few individuals. A few of the species also may be considered as nearly allied to some

* Both Professor Fontaine and Dr. Newberry use the old botanical classification which made the 'Angiosperms' synonymous with the Dicotyledons. It amounts to about the same thing here, however, on account of the almost complete absence of Monocotyledons in these floras.

occurring in the Greenland Cenomanian. These Cenomanian types are probably to be regarded as precursors not yet fully established, just as the Jurassic types must be considered as survivors not yet extinct.

"*The angiosperm plants present in the flora are much more important in giving a more recent facies to the flora.* They show quite a large number of species, but these are almost always local in occurrence, and are represented in most instances by few individuals. In a number of cases only one or two specimens were found. *It has been generally held that any considerable development of angiosperms in a fossil flora is strong, indeed conclusive, evidence that its age is not greater than that of the Cenomanian.* But apart from the evidence given by the older and predominant elements of the flora, there is reason to think that the Potomac flora is older than Cenomanian, even if we take into consideration the angiosperms alone.

"The conclusion above mentioned is based solely upon the fact that *in no flora older than Cenomanian has any considerable angiosperm element been found up to the present time*, but various writers have with justice maintained that it is improbable that the apparently sudden appearance of angiosperms in great force in the Cenomanian represents the true state of the case. It is highly probable that they had numerous precursors and ancestors, which existed in the Neocomian, and perhaps some of them, at least, in the Jurassic. It is probable that some of the forms called Protorhipis are ancient angiosperms. The existence then of numerous angiosperms in a flora which is predominantly Neocomian, but which contains many surviving Jurassic types, is just what we would expect to find. But we have direct evidence of the existence of angiosperms in the Neocomian. Heer has described from the Kome beds of Greenland, which are Urgonian in age, an angiosperm which he called *Populus primæva*. Only a few specimens were found. This single occurrence has remained so long unsupported by other discoveries of angiosperms in the Neocomian that doubts have been expressed concerning the correct localization of these specimens. It was thought possible that they really came from a younger flora. If the Potomac flora is in fact Neocomian, we have in this case a noteworthy illustration of the truth that positive evidence, however scanty, should outweigh any amount of negative evidence.

"The Potomac angiosperms in their general character give evidence of an age greater than Cenomanian. It is true that we find in them genera, and possibly some species, that survive into the Cenomanian and even down to the present time, but taken as a whole they form a peculiar group, *totally unlike the floras of the Dakota and the Amboy beds.* It is in the flora of the Dakota group, and the Amboy clays of New Jersey, especially the latter, that we would expect to find the greatest number of plants identical with Potomac forms. *Both of these floras are Cenomanian probably, and the Amboy flora, so far as yet known, is the one that comes next above the Potomac.* There are one or two species that are probably common to the Potomac and the Dakota beds, or that are nearly allied, but they are long-lived types, that come down to the present time with little modification.

"By the kindness of Dr. J. S. Newberry, who studied and described the New Jersey Amboy flora, I have been enabled to examine a large number of drawings of the New Jersey plants. *These plants are totally different from those of the Potomac. It is not certain that a single species survives from the Potomac into the Amboy beds. What is even more significant, even the genera that are most abundant in the Potomac and most characteristic of that formation have no representative in the New Jersey flora. It is clear that a very important gap exists between these two floras, and that an interval of time separates them, in which*

changes took place that produced an extensive destruction of vegetal types and altered the entire character of the flora.

"The localization of the species of Potomac angiosperms and their slight development, as shown in the very few individuals that in most cases represent them, indicate that these forms are, comparatively speaking, newcomers and precursors or ancestors of forms destined to become the predominant ones. This indication is confirmed by the character of a number of the species. They appear to be complex or comprehensive types, uniting in one form features that in the process of differentiation will later distinguish separate species.

"We may then conclude that the Potomac flora is not exactly like any known, *but on the whole coincides most nearly with that of the Lower and Middle Neocomian.* If this be true, then, we find that in this flora the development of angiosperms in considerable numbers has been pushed back through a long period of time."

In view of the fact that Professor Marsh, Mr. Gilbert and, to some extent, also Mr. Hill, in discussing the age of the Potomac formation, have referred to it as representing one definite epoch in the geological history of the Atlantic border, it does not seem superfluous to emphasize to any extent the fact which I have so prominently brought forward in my paper on The Potomac Formation,* and to which I also called attention in my own contribution to this discussion,† that the Potomac formation, as I have defined it and as also defined by Professor Marsh, including, as it does, the Older Potomac beds of Virginia, the iron ore belt, the purple clays, the white sands and white rocks (Albirupean of Uhler, Magothy of Darton), the Raritan and Amboy Clays of New Jersey, and the red micaceous-clay shales of Staten Island, Long Island and Block Island, as well as the variegated clays of Gay Head on Marthas Vineyard, represents a prolonged period in the geological history of the Coastal Plain equal to the entire Lower Cretaceous of Europe, *i. e.*, from the Wealden to the Gault of England, or from the lowest Neocomian to the highest Albian (Vraconnian)* deposits of the Continent.

With this fact in mind we are prepared to consider the still more startling statements contained in Dr. Newberry's Flora of the Amboy Clays. And first it will be necessary to determine precisely what Dr. Newberry meant by the Amboy Clays. This is made sufficiently clear by the following description (pp. 21–22):

"The Amboy Clays, to which our attention is now more particularly directed, outcrop in a belt extending diagonally across the State, forming the east bank of the Delaware River for a long distance above and below Philadelphia, leaving the Delaware at Trenton and stretching across the State at its narrowest point to Raritan Bay, and thence, passing over the southern portion of Staten Island, where, as in the State of New Jersey, they are largely worked for economic purposes. They are then interrupted by the Narrows and New York harbor, as well as by the crystalline rocks which occupy New York Island and underlie the northern portion of Brooklyn and the adjacent shores of Hell Gate. Eastward of this the Amboy Clays are generally covered with drift, but they appear at Glen Cove, Sea Cliff, and various other points on the north shore of Long Island, where it has been deeply cut into by glacial action and is now occupied by inlets from Long Island Sound. Possibly the whole length of Long Island is underlain by the Amboy Clays, as characteristic fossils

*Fifteenth Ann. Rept. U. S. Geological Survey, pp. 307–397, Washington, 1895.

†SCIENCE, N. S., Vol. IV., No. 99, Nov. 20, 1896, p. 757.

*See 16th Ann. Rept. U. S. Geol. Surv., p. 533.

have been found in the moraine on the extreme end of Montauk Point. Farther east, the clay series reappears on Marthas Vineyard and forms part of the noted cliff of Gay Head."

It is therefore clear that he includes in his Amboy Clays all the deposits north of the Delaware River, and that so far as these deposits are concerned they are the same as those to which Professor Marsh has referred in this section of the belt. As regards points farther south he has also made himself tolerably clear by the following language (p. 22):

"The southern extension of the formation has not been definitely traced, but it apparently thins out southward, appearing as an insignificant element in the series in Cecil county, Md., where Professor Uhler has described it as the bed of 'alternate sands and clays' which there rests on the Potomac and is overlain by the equivalents of the Cretaceous marl beds of New Jersey. South of this point it has not been recognized."

That Dr. Newberry found no close relations between the Amboy Clays and the Trias is also evident from the summary manner in which he dismisses this whole subject (p. 22):

"In New Jersey the Amboy Clay series is generally underlain by the Triassic red sandstones, which have been proved to be of the age of the Keuper or Upper Trias in Europe."

As to the real age of the Amboy Clays his opinions are so important that they need to be stated in full. After referring to the animal remains, in which he makes use of the same data as were employed by Professor Marsh, viz., the report of Professor R. P. Whitfield, he says (pp. 22–23):

"This evidence shows that the New Jersey clays occupy a position lower than the European chalk and higher than the upper member of the Trias. *Such other evidence as can be gained in regard to their precise geological age must be derived from their abundant plant remains*, among which are a number of species that are common to the Dakota sandstones of the interior of the continent, to the Atane and Patoot beds of Greenland —known to be Upper Cretaceous—to the Cretaceous clays of Aachen, Germany, and to the Upper Cretaceous rocks of Bohemia."

Turning then to the Older Potomac he discusses its relations to the Amboy Clays as follows (p. 23):

"The relation of the Amboy Clays to the Potomac formation of Virginia is not easily demonstrated, as the line of junction has not been fully traced, but we may say that the Potomac is the more ancient formation, and that probably *a somewhat long interval of time separated the epoch of the Potomac group from that of the Amboy Clays.* This is indicated by the *almost entire distinctness of the floras of the two formations*, which shows that *a great change took place during that interval in the character of the vegetation* which clothed the eastern shore of North America. Professor Fontaine has described, from the Potomac group of Virginia and Maryland, *365 species of plants, of which not one is certainly found in the Amboy Clays;* and the difference in the character of the vegetation is shown by the fact that in the long list furnished by Professor Fontaine *there are but 75 angiosperms* (about one-fifth of all), whereas in the New Jersey clays, throwing out fragmentary and doubtful remains, *of 156 described species all but 10 are dicotyledonous plants.*"

Having thus disposed of the possibility of the Potomac formation in Virginia being of the same age as the Amboy Clays, and having demonstrated its much greater antiquity, he sets about to discover the true geological affinities of the Amboy Clays. His conclusions may best be given in his own words (pp. 23–24):

"The relation of the Amboy Clays to the

Dakota group can be much more definitely determined, for the proportion between the angiosperms and the lower plants in the Dakota group is about the same as in the Amboy Clays, showing a similar stage of progress in the development of plant life. We have already obtained 12 species common to the two formations, a number that will undoubtedly be considerably augmented with the further exploitation of the Amboy flora. *The Dakota group is known to occupy about the middle of the Cretaceous system.* Until recently it was supposed to be the basal member of that system as developed on the North American continent, and it was believed that until about the middle of the Cretaceous period our continent had remained above the ocean level; but *it has been shown recently that considerable areas of North America are occupied by sediments deposited from the Cretaceous sea before the date of the Dakota formation*, and that on the northwestern coast, on Queen Charlotte Island, and in the Shasta group in California we have accumulations of sediment that *took place before the Dakota sandstones.* Mr. R. T. Hill and Dr. C. A. White have demonstrated that a considerable portion of the State of Texas is underlain by rocks that are the *equivalent of the Neocomian or Lower Cretaceous of the Old World.* Very recently, too, Sir William Dawson has found in the fresh-water coal-bearing deposits of western Canada fossil plants identical with some from the Kome group or Lower Cretaceous of Greenland; and a much larger collection of fossil plants obtained by the writer from the coal basin of the Falls of the Missouri in Montana, collected by Mr. R. S. Williams, contains many Kootanie or Lower Cretaceous plants, and, what is of still greater interest, a number of species that have been described by Professor Fontaine from the Potomac group of Virginia. *Thus the conclusions of Professor Fontaine as to the Wealden age of the Potomac are strikingly confirmed.* His arguments in favor of this view were that the Potomac flora was most like that of the Wealden of Europe, a few of the species being apparently identical, while it had nothing in common with any other flora known. *To this I ventured to add the suggestion that it could hardly be Jurassic,* as claimed by some writers, *since in no part of the world had angiosperm plants been found in the Jurassic, though in Europe the Jurassic rocks had yielded great numbers of plants and the flora had been carefully studied.* Now the finding of species identical with those of the Potomac in the Great Falls basin, and with them plants found in the Kootanie of Canada and the Kome deposits of Greenland, seems to place the question beyond doubt."

He was struck by the fact that several species were identical with those long ago discovered at Aachen by Dr. Debey, occurring in a formation whose geological position is known to be Upper Cretaceous, and he took the trouble to visit that locality and examine Debey's collections, a considerable number of which he purchased and brought to America. After carefully comparing these with those of the Amboy Clays, and in the light of an extensive acquaintance with other similar floras, he concludes the introductory part of his work with the following general statement (p. 33):

"The mode of accumulation of the beds at Aachen seems to have been similar to that of the Amboy Clays and the Potomac group; that is, they are local estuarine beds resting upon the Paleozoic rocks and composed of the wash of the neighboring land, in which were buried great numbers of leaves and trunks of the trees which grew upon that land. The trunks are now converted into lignite, and they are as conspicuous an element in the lithology of the group as in New Jersey. Dr. Debey supposed that his collection contained 300 to 400 species of angiosperm plants. This is perhaps an exaggeration, for he included in

his list a great many doubtful fragments; but when the floras of the Aachen beds and those of the clays of New Jersey shall be fully studied and illustrated it will undoubtedly be found that the botanical aspects are the same, and that there are perhaps as many species identical in the two formations as in those of Greenland and New Jersey. Hence, *we may fairly infer that the collections of plants from the New Jersey clays, the Dakota group, the Patoot and Atane beds of Greenland, the Aachen series of Germany, and the plant-bearing Cretaceous rocks of Bohemia fairly represent the vegetation of the world during the middle and latter portions of the Cretaceous age.*"

I do not wish to conceal the fact that Dr. Newberry's views are somewhat extreme in the direction of raising the Amboy Clays up to a level with the Dakota group of the West and the Aachen and Atane beds. My own explanation has always been that the Greenland beds are simply the northeastern extension of the Amboy Clays and Island Series, but that they may nevertheless represent a somewhat higher horizon in the same way that the Amboy Clays are higher than the Older Potomac of Maryland and Virginia, although belonging to the same general belt, either through the destruction of the lower members of the formation or because the continent at those points was out of water while the Virginia beds were in process of deposition. On this theory it would be perfectly natural that a large number of Amboy Clay species should have survived with little change into the slightly more modern period at which the Atane beds were deposited. In confirmation of this, and against the view of the great similarity between the Amboy Clay flora and that of the Dakota group, I have shown that most of the species common to the two are such as Professor Lesquereux, in studying the Dakota group, identified with Greenland forms, and I have also shown that, in a few cases at least, such identifications were not justified.* I therefore still think that the Amboy Clays, including the Island Series, are lower than Cenomanian, but any attempt to place them below the extreme summit of the Lower Cretaceous would, in the light of these facts, involve assumptions too violent to be entertained.

It certainly cannot be justly said that all this evidence, because derived from fossil plants, is without value. The floras, both of the Older and Newer Potomac, are altogether too rich and too definite to be disregarded. Taken as a whole they show as well marked differences in the character of the vegetation as could be desired. It is true that geologists and paleozoologists are generally unprepared to weigh the evidence from fossil plants, but in this case they need not know the specific nature of the plants. It is sufficient to compare the illustrations, say, of The Flora of the Amboy Clays, with those of The Potomac or Younger Mesozoic Flora.† They may be regarded simply as pictures, and it requires no practiced eye to discover that they are utterly unlike. A child would readily perceive the difference between a plate illustrating the ferns, cycads, and conifers of the Older Potomac and one illustrating the broad dicotyledonous leaves of the Amboy Clays. The contrast would be still greater if made with any of the true Jurassic floras of the world, as, for example, that of France, so profusely illustrated by the late Marquis Saporta in eight volumes containing 300 plates.‡ It therefore seems to me that the two works now before us, together with the early illustrated one of Professor Fontaine, furnish

* The Potomac Formation. 15th Ann. Rept. U. S. Geological Survey, pp. 373–374.

† Monographs of the U. S. Geological Survey, Vol. XV., plates.

‡ Paléontologie française. Végétaux. Terrain Jurassique, par le Marquis de Saporta, 4 vols. each of text and atlas, Paris, 1873–1891.

the most complete demonstration that could be made of the essential difference between the Older and the Newer Potomac, and all the proof that should be necessary to establish my fundamental thesis that, while the former must lie very near the base of the Lower Cretaceous and may even extend somewhat into the Upper Jurassic, the latter must be correlated with the extreme Upper members in the European series of Lower Cretaceous deposits.

So far as I am concerned, I have no interest whatever in the mere question of names, for example, as to whether the Wealden should be called Cretaceous or Jurassic, and I have done what I could to show that the Older Potomac was laid down under conditions very similar to those of the Wealden of England and that, in all probability, the process of deposition of portions of both at least was going on at the same time. If Professor Marsh, throughout his papers, had substituted the term Wealden for 'Jurassic' it is doubtful whether they would have given rise to any discussion, so far as the Maryland beds containing the vertebrate remains are concerned. But he has chosen to employ the term Jurassic without qualification, and there are indications that he does not mean to correlate the Potomac formation with the Wealden, but regards portions of it at least as Oolite. In his last paper* he says: "It cannot, of course, be positively asserted at present that the entire series now known as Potomac is all Jurassic, or represents the whole Jurassic. The Lias appears to be wanting, and some of the upper strata may possibly prove to belong to the Dakota." This would give the Potomac formation an enormous extension, viz., from the base of the Oolite to the Upper Cretaceous. The less than twelve hundred feet that it has been possible thus far to measure in the Potomac formation* would seem to be an exceedingly thin stratum to represent such a period, even after allowing for any amount of contemporary erosion.

Professor Marsh says that it is a reproach to science that the Jurassic has not been discovered in the eastern part of the continent. This may be true, provided it exists, but if it does not exist the finding of it would be a still greater reproach to science. His section would seem to indicate that he regards the Dakota group as forming the lowest member of the Cretaceous. This has never been maintained by any geologist. It is true that it was claimed for many years that it represented the lowest Cretaceous in America, but those who made this claim assumed the absence of the Lower Cretaceous in any part of this country. Professor Marsh's assumption, if that is what he means,† would carry with it some peculiar consequences; it would make the beds that are now known to underlie the Dakota group (the Comanche series, the Kootanie, the Shasta group, and the Queen Charlotte Island group, as well as the Potomac formation) all Jurassic. A number of these, especially those of Texas and the Pacific coast, are marine deposits and contain abundant invertebrate remains, fully establishing their Lower Cretaceous age. But

* Amer. Journ. Sci., 4th Ser., Vol. II., December, 1896, p. 436.

* 15th Ann. Rept. U. S. Geol. Surv., p. 339.

† Since this was written I have had an interview with Professor Marsh and was glad to learn that he disclaims such an interpretation of his section. He maintains that the explanation on p. 144 of the 16th Annual Report United States Geological Survey was intended to prevent this impression from being gained and called my attention to the following words, and especially to those in italics: "This diagram represents the principal geological horizons *of vertebrate fossils* in North America, *as determined by the writer.*" To have justified such an interpretation his diagram should have embraced no formations from which vertebrate fossils had not been determined by him. A glance at the diagram, however, shows that there are two groups opposite which he has indicated no vertebrate remains, and one of these unfortunately is the Dakota group.

this is not all. The Shasta group, at least, is directly underlain by true Jurassic beds. It is altogether improbable that those who have established the age of these deposits from what is admitted to be the very best paleontological evidence will abandon this determination and adopt that of Professor Marsh.

When I made my slight contribution to this discussion* only Professor Marsh's two papers on the 'Geology of Block Island' had appeared, in which the evidence to establish his position was promised in the future. From the confident manner in which he spoke in those papers all expected that his next paper would contain an account of the discovery of Dinosaurs and other vertebrate remains on Block Island, Long Island, Staten Island, and Marthas Vineyard. His much fuller paper in the December number of the *American Journal of Science* is disappointing in not furnishing this evidence. Every one, I believe, would welcome any facts bearing on the subject, and all are equally interested in considering all possible data. His failure to present such evidence in this paper leads some skeptical people to suppose that it does not exist. Speaking of Gay Head, he says (p. 437): "The striking resemblance between the variegated cliffs at Gay Head, the Potomac hills in Maryland, and Como bluffs in Wyoming, will impress everyone who has seen them. That all three are of essentially the same geological age, I have good reason to believe. Two of them are certainly Jurassic, as demonstrated by typical vertebrate fossils, and *I hope soon to prove* that Gay Head, so similar in all other respects, also contains the same characteristic vertebrate fauna that marks the Jurassic,—the long missing formation on the Atlantic coast."

It would have been much better if he had actually proved this. It is always unsafe in geology to predict what we shall prove; such sweeping generalizations as Professor Marsh makes are very hazardous. To stand on Block Island and correlate its formation with that of Como bluffs in Wyoming is not the modern method of geological investigation. As he says: "The Gay Head Indians are not hostile." I did not find them so, neither did Mr. White when he made his large collection of fossil plants there. They would probably not harm a vertebrate paleontologist any more than a paleobotanist, and I submit that there is a better way of geologizing than to sit at one's 'study window' at New Haven and 'look across the Sound to Long Island.'

It is still fashionable to disparage the evidence from fossil plants, and Professor Marsh's papers would have been incomplete without the usual amount of this kind of matter. This is not the place to enter into a defense of fossil plants or to point out their value to geology. I have attempted to do this on former occasions.* I only desire here to refer to the two authors whose works I have considered as among those who do not take this view. Professor Marsh has followed most other writers in digging up the errors of the early paleobotanists while ignoring the work of the later ones, but I am surprised that he should have adopted the view which resulted from these errors, and which has long been exploded, that there is any lack of harmony between the evidence which plants afford and that of other forms of extinct life. Dr. Newberry was one of the first to correct this error and to insist that when all the evidence from plants and animals should be in there would

*Science, N. S., Vol. IV., Nov. 20, 1896, p. 757.

* Principles and Methods of Geologic Correlation by Means of Fossil Plants. American Geologist, Vol. IX., pp. 34–47; Principes et méthodes d'etude de corrélation géologique au moyen des plantes fossiles, Compte-rendu de la cinquième session du Congrès géologique international, Washington, 1891, pp. 97–109. Cf. also: Fossil Plants as an aid to Geology, by F. H. Knowlton, Journal of Geology, Vol. II., pp. 365–382.

be no lack of correspondence in their teachings. This truth is now receiving a signal confirmation by the discovery of fossil plants in marine shell-bearing deposits, especially in the Lower Cretaceous of Portugal, of Texas, and of California. Neither is the 'botanical time piece' either too slow or too fast, and the organic pendulum has always swung in perfect unison on both sides of the Atlantic. LESTER F. WARD.

WASHINGTON, D. C.

THE AMERICAN MORPHOLOGICAL SOCIETY.*

The Rôle of Water in Growth. C. B. DAVENPORT.

In developing tadpoles of various amphibia the amount of water contained was determined at short intervals between the time of hatching and midsummer. These determinations showed that during the first week or two of development the amount of dry substance in the embryo remains nearly absolutely the same as it is in the just-hatched larva, where it constitutes little less than half of the whole weight. During this period the immense increment in weight which accompanies the outlining of the form of the larva and its organs is due almost solely to imbibed water. It is the specific imbibition of water then which determines the direction of differential growth in the developing tadpole. As in plants this 'grand period of growth' is followed by one of histological differentiation, during which the absolute (and relative) quantity of dry substance increases rapidly.

The Structure and Function of the Midgut in Terrestrial Isopods. J. P. MCMURRICH.

The general result of the study of the Isopod midgut may be summed up as follows:

1. The so-called 'midgut' of the terrestrial Isopods is of ectodermal origin and is in reality a portion of the proctodæum.

2. It is lined by an impervious layer of chitin.

3. The cells which compose it possess no definite boundaries and form an epithelial syncytium.

4. The fibrils which traverse the cells from the basement membrane to the layer of chibin are, throughout the greater part of their extent, of the same material as the basement membrane, their central ends, however, being apparently chitinous. They are not protoplasmic, as Ide has maintained.

5. The nuclei frequently show great irregularities of form; these irregularities are sometimes due to injury, but in other cases appear to be normal and to indicate a power of amœboid movement.

6. The conjugation of the nuclei, described by Ryder and Pennington, does not occur.

7. Fragmentation of the nuclei occurs as a degenerative change, but amitosis for growth or regeneration, if occuring at all, is infrequent.

8. The increase in size of the 'midgut' appears to be due not to an increase of the *number*, but to an increase of the *size*, of the cells present at the close of embryonic life.

9. Feeding experiments indicate that the midgut does not possess an absorptive function; it merely serves for the passage of undigested material to the exterior.

A paper giving in detail the evidence on which these conclusions are based is in the hands of the editor of *The Journal of Morphology*.

The Result of the Suspension of Natural Selection as Illustrated by the Introduced English Sparrow. H. C. BUMPUS.

Over 1,700 eggs were critically examined, and 'curves of frequency' were drawn to illustrate the differences between the European and American specimens. It was found that the American eggs presented a much greater amplitude of variation than the European, that they were smaller and that they were of a strikingly different shape.

* Concluded from page 392.

The bearing of these facts upon the current theories of degeneration, panmixia, etc., were indicated.

The American eggs ranged in length from 18 mm. to 26 mm., while the shortest and longest European eggs measured respectively 18.5 mm. and 25 mm. The typical American eggs, moreover, had an average length of approximately 21 mm., while the European eggs averaged at least 1 mm. longer.

The ratio of breadth to length, *i. e.*, the ratio of the lesser to the greater diameter, showed much greater sphericity on the part of the American eggs, though also in respect to this feature the American eggs presented a much greater amplitude of variation.

The extremes of variation in shape and color were determined by a process of 'disinterested selection.' After having placed a secret mark upon each American egg, the eggs of both countries (863 American and 863 British) were thoroughly mixed together in a single tray. A disinterested person was then requested to select from the mixture 100 eggs that appeared to him to present extremes of shape variation. If eggs from the two countries were equally variable, of course approximately the same number from each would be selected, and if the American specimens were more variable, more American eggs would be selected. The result was in harmony with the evidence derived from the comparison of length and the ratios of breadth to length. Of the selected eggs, eighty-one were American and only nineteen were English, over four times as many of the former as of the latter.

The same method was adopted for the determination of color variation and with the result that eighty-two of the examples of extreme color variation were found to be American and only eighteen British. It was pointed out that this large proportion of extreme color variation on the part of American eggs was not only interesting in itself, but that when the figures are compared with those representing extreme variation in *shape* the significance of both results is enhanced. Not only is the preponderance of variation among American eggs very obvious, but in both cases, in shape and in color, it is almost precisely the same.

It was concluded that the data, whether gathered from comparisons of length, ratio of breadth to length, shape or color, all point in the direction of a general structural modification.

On the Plankton of Brackish Water. G. W. Field.

Investigations of the Plankton are now being carried on at the Marine Laboratory of the Rhode Island Experiment Station at the Great Salt Pond, near Point Judith, in South Kingston, R. I. It is intended to continue the observations, both summer and winter, for a term of years.

The pond is about five miles long and comparatively narrow. Its area is estimated at 1,500 acres. At the northern end, where the river enters, the water at the surface is quite fresh (specific gravity 1.000); at the bottom it is slightly saline (specific gravity 1.0055). The south end communicates with the sea. The specific gravity of the water at the outlet is 1.025. At points between the north and south ends of the pond are found all intermediate degrees of salinity.

Examination of the number of organisms per litre shows that the number is greatest in those areas where the specific gravity is between 1.008 and 1.020 (*i. e.*, the middle portion of the pond), and that in passing in either direction, southerly towards the ocean, or northerly towards the river, the number diminishes.

The most important constituents of the Plankton, named in order of the number of individuals, are: diatoms and algal débris;

ciliated infusoria; arthropods; (copepods, amphipods; ostracods; decapod larvæ and larval tracheata); rotifers; annelid larvæ; ctenophores; medusæ. In its general character it more closely resembles Haliplankton than Limnoplankton, the marked exceptions being the presence of rotifers and the absence of cladocera.

It has been frequently observed and recorded that copepods come to the surface in vast numbers at night. We have frequently observed that on certain days they are at the surface in equal abundance. Their presence at the surface appears to be independent of light and darkness, or of meteorological conditions, but correlated with the presence at the surface of certain species of diatoms, or of quantities of algal débris; observations confirming the belief that these diatoms and amorphous organic materials are the principal food of copepods and of young decapod larvæ.

Rotifers occur in great abundance during July, August and September, but we have found them at the surface only during the day, and near the bottom during the night.

Cordylophora and a nudibranch mollusc are found in water whose specific gravity never rises above 1.005.

Investigations are now in progress to discover the cause of the phenomena noted by us, that ctenophores and medusæ (*Dactylometra*), which are brought into the pond by the tide, are checked in their growth, and after several months of residence in the pond show but a very slight increase in size. The same causes have possibly resulted in the various species of *Nereis Balanus*, and molluscs described as inhabiting only brackish water, and which differ from similar marine species mainly in their smaller size.

Our earlier methods of plankton collection were by means of fine nets, and by sand filtration of known volumes of water after the method of Henson, Reighard, Sedgwick-Rafter, Peck and others, but these have been superseded by use of the *Planktonokrit*, invented and described by Dr. C. S. Dolley.* The centrifugal method is a distinct advance, and materially reduces the error when dealing with all organisms thus far met with, except the Cyanophyceæ. But with steam power it is confidently expected that enough centrifugal force can be developed to throw out even these.

The machine is particularly valuable as a rapid, sure method for collecting the microscopic plankton, and its use will disclose many forms hitherto rare or unknown. As used by us, the two reservoirs, each of one litre capacity, are filled with water drawn from a known depth by means of a valved tin tube. For control purposes both reservoirs are used. After revolving 2 to 5 minutes the volume of organic matter is read on the graduated tube; the tubes are then unscrewed, and the contents washed out by a pipette and filtered distilled water into a tube of narrow lumen graduated to $\frac{1}{100}$ of a cc. After settling for the necessary time, either with or without treatment with Formalin, the volume is read and compared with the volume noted upon the graduated tube of the reservoir. This is necessary from the fact that certain forms are packed more closely than are others by the centrifugal force. The volume of water is then made 5 cc.; the organisms are distributed evenly by gentle shaking or by a pipette, and the number of individuals of each species is enumerated according to the Sedgwick-Rafter method.

Nocturnal Protective Coloration of Mammals, Birds, Fishes and Insects. A. E. VERRILL.

Much has been written in respect to the imitative and and protective colors of mammals, birds, insects, etc., and the bearing of these facts on natural selection, to which

*Proc. Acad. of Nat. Sci. Philadelphia, May, 1896.

they are unquestionably due, is well known. Nearly all the cases cited by authors relate to colors as seen by daylight. I wish to call attention to the importance of studying the forms and colors of animals with reference to their appearance and protective value as seen by moonlight, starlight and in the dusk of early morning or the twilight of evening, when vast numbers of insects, birds, small mammals, etc., are most in need of protection against their predacious enemies, which generally hunt their prey at such times. The danger to most birds and to diurnal insects is due to their sleeping more or less exposed to view, but the danger to most of the smaller mammals and nocturnal insects, fishes, etc., is due to the fact that they are most active at night or in the twilight, and therefore more easily observed by their enemies. Moreover, the predacious species need protective or imitative colors at night, in order to approach their prey unobserved.

Moonlight and skylight give very black shadows in which dark brown, dark gray and black animals are nearly or quite invisible. Black shadows of foliage are apt to be broken up by patches of white moonlight. Therefore patches of white or light yellow on dark or black animals are imitative of such moonlight effects, and as they serve to break up the dark outlines of beast or bird, they are very effective as a protection at night.

Thus we find among nocturnal carnivores many instances of black colors, as the mink, fisher, bear, etc., and of black and white ones, as the skunk, badger, etc. So among the small species preyed upon, there are numerous birds that are black, black and white, black and yellow, etc. All such strongly contrasted colors are more likely to be of value for protection at night than in the daytime. This also applies to the butterflies and other bright colored diurnal insects whose colors often have no obvious relation to their diurnal surroundings, but blend with the colors of the flowers or foliage on which they roost at night. Many of our large red and brown butterflies of the genus *Argynnis*, etc., have bright silvery spots on the under side of the wings, so that they are conspicuous objects in the daytime. But I have observed them at roost on the golden-rods and other favorite flowers by moonlight, when the colors of their folded wings blend well with those of the flowers, and their silvery spots glisten like the dewdrops around them. Thus their conspicuous markings become protective at night.

A great number of field mice, shrews, moles, etc., have dark gray or grayish brown colors, more or less like the common rat and mouse. Such animals are nocturnal in their habits, usually hiding in holes by day. Their colors are not protective in the daylight amongst green herbage, but at night they are eminently so, for they are almost invisible in green grass, if quiet, as I have often observed, even in good moonlight. Animals that live among the stalks of reeds or shrubs may gain protection by having conspicuous dark stripes. No doubt the tiger is better concealed by his stripes, while in his native haunts, in the night than in the daytime. The same is true of the leopard and jaguar, and perhaps of the zebra. Many fishes that rest at night among eel grass and sea weeds have conspicuous transverse or longitudinal black stripes, which are highly protective in a dim light, for they look like the dark stems and shadows of the weeds, and serve to break up or conceal the outline of the fish. Black tails and fins serve the same purpose. Such markings of fishes are often more conspicuous at night than in the daytime. All the cases referred to above seem to be the direct results of long-continued natural selection.

Nocturnal and diurnal changes in the color of certain fishes, with notes on their sleeping habits. A. E. VERRILL.

While investigating the nocturnal habits of fishes, etc., in the aquaria of the laboratory of the U. S. Fish Commission, at Wood's Holl, in 1885 to 1887, I unexpectedly discovered that many species of fishes, and also the common squid (*Loligo Pealei*) take on special colors at night, while asleep, or at rest, in a feeble light. These observations have not hitherto been published, because I hoped to have had opportunities to continue them and make them more complete. It is now my hope that others, with better opportunities, may take up the subject. My observations were made after midnight, when everything was quiet, for fishes sleep very lightly. The gas jets near the aquaria were turned down as low as consistent with distinct vision, and great care was taken not to jar the floor or furniture. With these precautions I was able to detect many species in the act of sleeping. Some of them took unexpected positions when asleep.

The most common change in colors of the sleeping fishes consisted in a general darkening of the dark spots, stripes or other markings, by which they become more distinct and definite. This was the case with various flounders, minnows (*Fundulus*), the black sea-bass (*Serranus furvus*), the sea-robins (*Prionotus evolans* and *P. palmipes*), the king-fish (*Menticirrus nebulosus*) and several other species.

In all these cases the change of color is in the direction of increased protective coloration, the dark markings being generally connected with their habits of resting naturally at night among eel-grass and sea weeds. The young fishes often showed greater changes than the adults.

Other species showed a much greater change in color, for the pattern of coloration was itself entirely changed. Thus the common scup, or porgy (*Stenotomus chrysops*), while active in the daytime, is of a beautiful silvery color with bright, pearly, iridescent hues. But when asleep it takes a dull bronzy tint and is crossed by about six conspicuous, transverse, black bands, a coloration well adapted for concealment among eel grass, etc. If awakened by suddenly turning up the gas, it almost instantly takes on its silvery color, seen in the daytime. This experiment was tried many times.

A common file-fish (*Monacanthus*), which is mottled with dark olive-green and brown in the daytime, when asleep becomes pallid gray or almost white, while the fins and tail become black. These are nocturnally protective colors. The file-fishes, when asleep, often lean up obliquely against the glass of the aquaria, with the belly resting upon the bottom in very queer positions. The tautog, or black fish (*Tautoga onitis*), commonly sleeps on one side, often partly buried in sand or gravel, or under the edges of stones, much after the fashion of flounders, thus suggesting the mode in which the flounders may have developed from symmetrical fishes in consequence of this mode of resting, becoming chronic as it were.

Notes on the Phylogeny of the Carnivora. W. B. SCOTT. (Read by title.)

The Peripheral Nervous System of Nereis Virens. F. E. LANGDON.

This study was made partly on material living and unstained; partly on that stained by methelene blue and examined either fresh or fixed by Bethe's method, and partly on that prepared by the more common methods.

The spindle-shaped sensory cells described by Retzius as isolated are really grouped into semi-organs which have a definite distribution over the body. Each organ consists of a fusiform group of cells whose bodies lie below the epidermis or in its base. The cuticular markings over the

organs in the appendages of the body are like those over the sense organs of Lumbricus. Over the body itself each cuticular marking is concave on the exterior and the very thick cuticula encloses beneath each marking an ovoid cavity through which pass the outer ends of the sensory cells. Each sensory cell usually bears several sensory hairs, and these hairs cannot be retracted normally as supposed by Retzius.

In the gill lobes of the parapodia, the base of the palps, the prostomium and several anterior metameres is found a second kind of sense organ, apparently a light-perceiving organ, not previously described.

In the center of each organ is a slender, flexible tube, open to the exterior and continuous with the cuticula. Around this tube the club-shaped peripheral ends of 100 or more bi- or multipolar nerve cells are arranged in a spiral of from 8 to 14 turns. The bodies of these cells are irregularly grouped in or beneath the base of the epidermis; the central nerve fibre passes to the central nervous system; the peripheral fibre is at first slender, but ends in the club-shaped enlargement mentioned above. The tip of this enlargement, and sometimes the entire enlargement itself, is filled with a clear, highly refractive, lens-like substance.

The central fibres from both diffuse and light-perceiving organs end in *apparent* nerve baskets around the ganglion cells of the central nervous system.

Beside the four eyes and the two pairs of sense organs of unknown function described by Retzius, the prostomium contains a third pair of organs near the anterior pair of Retzius. The groups of ganglion cells described by Retzius near the anterior eyes are not, as that author supposed probable, concerned with the innervation of the eyes; the preparations from which this study was made show plainly the nerve bundles passing from the eyes to the brain.

Epidermal Sense Organs in Certain Polychætes. Margaret Lewis.

The epidermal sense organs were studied in two members of the annelid family of the Maldaniæ, both by means of ordinary methods and by the use of methylin blue. The following are the chief conclusions:

1. That multicellular sense organs are present throughout the integument of the two polychæte annelids *Clymenella torquata* and *Clymene longa*.

2. That the cells of these sense organs are spindle-shaped, bipolar nerve cells.

3. That the individual cells making up a sense organ show great variation in the distance of the enlargement containing the nucleus from the cuticula. This enlargement may be close to the cuticula, at half the height of the epidermis or sunk to the base of the epidermis.

4. That the cells of the sense organs possess at their peripheral ends sensory hairs.

5. That from the deep end of each cell proceeds one process which turns at an angle beneath the epidermis toward the central nervous system.

6. That in many respects the sensory cells of these epidermal sense organs show a striking resemblance to the epidermal sense cells which Retzius describes for *Nereis;* the chief difference being that Retzius found only isolated sense cells in the epidermis of *Nereis*, whereas in these Maldanids these sense cells without exception are grouped into definite sense organs.

The Eyes of Limax maximus. A. P. Henchman.

The eye consists of six parts: (1) Optic ganglion, (2) Sclerotic capsule, (3) Retina, (4) Vitreous humor, (5) Lens, and (6) Corneal layer. The optic ganglion is a funnel-shaped enlargement of the optic nerve, containing oval nuclei. The sclerotic capsule is a thin, firm layer of connective tissue, containing at intervals oval

nuclei which are much flattened. The retina is composed of nerve fibres and a single cell layer embracing two kinds of cells: viz. (*a*) pigment cells and (*b*) sensory cells. In sections along the chief axis of the eye the retina presents three concentric zones; the innermost, of a pale yellowish color, is composed of the so-called cones; the middle is the pigment zone and exhibits higher radial bands alternating with broader masses of more opaque appearance; the outer zone, which is destitute of pigment contains, nuclei of two kinds: large, pale, circular ones, and smaller, elongated, deeply staining ones. The branches of the optic nerve constitute the outermost portion of this clear zone next to the sclerotic.

These three zones are really made up of a single layer of cells, the retinal cells, of which there are two kinds: the unpigmented, or sensory, and the pigmented. The pigment cells are club-shaped and contain granules of dark brown pigment. Their central ends all terminate at nearly the same level and rather abruptly. Their basal ends run out into long fibres which are often branched. The lighter radial bands of the middle zone are produced by the sensory cells. These extend nearer to the center of the eye than the pigment cells, each ending in a club-shaped portion that is rounded at its free extremity. This club-shaped prolongation is surrounded by a thick mantle of substance having a radially fibrous structure. These prolongations with their mantles constitute the 'cones.' The unpigmented, or sensory, cell itself shows throughout its whole course a longitudinally fibrous structure, contains no pigment and terminates at its deep end in a large number of fibrous branches.

The sensory and pigment cells are definitely grouped into sets. Each set, or ommatidium, comprises a single central sensory cell and a small number (5–7) of pigment cells surrounding it.

In front of the pigment cells of the antero-ventral margin of the chief eye its sclerotic capsule is somewhat enlarged so as to include a hitherto undescribed structure, which reproduces on a smaller scale almost exactly the conditions found in the chief eye. In one respect only does it differ from the chief eye; the cells corresponding to the pigment cells of the retina *contain no pigment granules.* In other respects it presents the same histological conditions and a similar arrangement of the histological elements. The innervation of this accessory retina is effected by nerve fibres from the optic nerve, which accompany those distributed to the antero-ventral portion of the chief eye. The cells composing the accessory eye are separated from the pigment cells of the adjacent parts of the chief eye by elongated cells with small oval nuclei. At the angle formed by the juxtaposition of the two retinas are seen several very large nuclei. Some of these are probably the nuclei of sensory cells, but there are others which are much larger than the nuclei of the sensory cells and do not seem to be connected with cells terminating in fibrous cones; they have a striking resemblance to the large ganglionic cells of the central nervous system. These are the largest nuclei found within the eye capsule.

The Optic Lobes of the Bee's Brain. F. C. KENYON.

In the optic lobes of the bee's brain there are, as in other hexapods, three masses of fibrillar substance surrounded more or less completely by masses of cells. The middle and inner masses or bodies may in section be recognized as composed of a pair of lenticular, densely and finely fibrillar bodies or capsules, fitted one within the other and with their convex surfaces directed outward, their concave surfaces inward. The capsules in each body are separated from one

another by a loose mass of fibres running parallel to the surfaces of the capsules.

In the middle body this middle layer of fibres is gathered into a bundle at the anterior margin of the body and passes out towards the central portion of the brain. Almost immediately the bundle divides. One division goes to the calices of the mushroom bodies, forming thus the antero-superior optic tract; the other to the lower posterior portion of the brain, forming the antero-posterior optic tract.

From the middle loose layer of fibres of the inner body several bundles arise, all penetrating the hinder portion of the brain. One bundle forms an upper, another a lower commissure between the two optic lobes.

The fibrillar elements from the retina terminate in five branches and thus help to form the outer mass of fibrillar substance. From cell bodies between the basement membrane of the retina and this mass fibres pass inward, give off short, fine fibrils connecting with the terminating fibrils just noted, and then go further inward, forming, with their fellows, the outer chiasma and terminate in a bunch of fibrils in the outer capsule of the middle body. These form neural elements 1. From cell bodies between the outer chiasma and the middle body fibres penetrate the outer capsule of the latter, giving off a bunch of lateral fibrils connecting with the terminals of elements No. 1. The main fibre then crosses the body to the inner capsule, gives off in it a group of short fibrils, then leaves the body, and after forming, with their fellows, the inner chiasma, finally terminate in the outer capsule of the inner body of the lobe.

From cell bodies between the margins of the two bodies neural elements No. 3 arise, that bear the same relations to the inner body and its capsules as do elements No. 2 to the middle body. Passing out of the concave surface of the inner body some of the elements are gathered into a bundle that passes forward, forming the anterior optic tract and terminate in the optic body, a small oval mass of fibrillar substance above the antennal lobe. Others go upward as a bundle of fibres to the calices of the mushroom bodies, forming thus the postero-superior optic tract.

The branching terminals of the fibres forming the antero-superior optic tract seem to connect with the lateral fibrils of element No. 2 in the inner capsule of the middle body, and the terminals of the fibres forming the posterior optic tracts connect similarly with the inner lateral fibrils of elements No. 3.

A stimulus to a retinal element may reach the central portion of the brain by passing over three or four neural elements and may reach either the mushroom bodies, the optic body or several portions of the posterior part of the brain, or passing over more elements it may reach all these regions, and even be transferred over the two optic commissures to the opposite lobe, and thus indirectly reach the mushroom bodies, the optic body or the posterior portion of the brain on the other side.

The earliest differentiation in the central nervous system of Vertebrates. A. Schaper.

The speaker presented briefly some of the results of his recent investigations on the histogenesis of the central nervous system which are to be published in extenso in the 'Archiv für Entwicklungsmechanik.' The essential points of this paper were the following:

1. The so-called '*Keimzellen*' of *His*, lying near the central cavity of the neural tube, along the membrana limitans interna, are not at all to be considered as a special type of cells in contrast to the main epithelial part of the medullary wall. They are nothing else than *epithelial cells in process of continuous proliferation* and serve in the earliest stage of develop-

ment only to increase the number of the epithelial components or their products of metamorphosis, the ependymal cells. By the continuous proliferating activity of the '*Keimzellen*' a considerable number of ependymal cells (at least in the case of higher Vertebrates) are gradually created. Thus a definite framework is brought into existence, in the meshes of which further processes of cellular development take place on prescribed lines. About this time the most important differentations in the neural tube begin. The descendants of the '*Keimzellen*' ceasing gradually to turn into ependymal cells are transformed into the mother cells of future nerve cells which, provided with certain histological characteristics, are expressively named '*neuroblasts.*' In the highest Vertebrates, moreover, the offspring of the '*Keimzellen*' appear, provided with still *higher capacity of differentiation*, in so far as they produce a generation of '*indifferent cells*,' which later on differentiate into either *nerve* or *neuroglia cells.*

2. The *ependymal cells*, as a whole, are to be considered as a *phylogenetically older* or an *embryonic stage* of supporting tissue which, in the ascending series of the Vertebrates or in the progress of ontogenetical development, loses gradually its morphological and physiological importance, and is at last replaced by a *cœnogenetic* form of supporting tissue, the *neuroglia* proper, the elements of which originate, like the nerve cells, from 'indifferent cells.'

3. The '*indifferent cells*' have the property of *locomotion* (especially developed in those of the cerebellum, where they give rise to the formation of the superficial granular layer of *Obersteiner*), a characteristic of the formative elements of the nervous system which is of great importance for a higher structural complication of the latter.

4. The so-called '*Mantelschicht*' of *His* is in the higher Vertebrates composed of 'indifferent cells' (not only of neuroblasts as *His* supposes), which later on differentiate into either *neuroblasts* or *spongioblasts* (the latter being the mother cells of neuroglia cells).

5. Not all *indifferent cells* undergo simultaneously such an early process of differentiation. A certain number remain for a longer or shorter time in an indifferent condition possessing moreover the property of *further propagation*, which activity is clearly shown by the appearance of karyokinetic figures within the 'Mantelschicht' during a certain period of development. This further proliferation of the structural elements of the neural tube is obviously adapted to furnish the material for the later development and completion of the intricate structure of the nervous system as it is found especially in the higher Vertebrates.

6. It is not improbable that these *indifferent cells* may play an important rôle in *regenerative processes* within the central nervous system even in postembryonic periods.

1. *Cranial Nerves of Bdellostoma dombeyi.* (Read by title.)

2. *The Structure of the Organ of Corti in Adult Man.* (Read by title.) H. AYERS.

The Visual Centers of Arthropods and Vertebrates. W. PATTON.

It is assumed, based on evidence advanced elsewhere, that the median ocellus of *Limulus* and the Arachnids is homologous with the pineal eye of Vertebrates, and that the lateral eyes of *Limulus* and the Merostomata are homologous with the lateral eyes of Vertebrates. In the Arachnids (*Limulus*), and probably in Vertebrates, the distal end of the median eye stalk contains one or more pairs of medianly fused ocelli. (1) From the proximal end of the eye stalk the median eye nerves separate, and encircling the posterior part of the fore-brain, just in front of the posterior commissure, terminate in *Limulus*, on the hæmal side of the fore-brain, in two great lobes which in

position, form and development resemble the lobi inferiori of fishes. In fishes, amphibia and reptiles two strands of nerve fibres associated with the median eye, and springing from a point just in front of the posterior commissures, extend around the sides of the fore-brain and terminate in the neighborhood of the lobi inferiores. Thus the anatomical relations in both Vertebrates and Arachnids are essentially alike. (2) The lateral eyes of *Limulus* and the related fossil forms, owing to more rapid growth of the hæmal margins of the eye, are kidney-shaped, with the helum directed toward the neural side. This gives the most advantageous and economical arrangement of the ommatidia on the convex surface of the carapace of such animals. If such an eye is infolded and forms a part of the brain, as our theory demands, it will not only be turned inside out, but upside down. The most rapidly growing edge will then, in a Vertebrate, be on the neural side and the retina will be kidney-shaped. Under such conditions, as there is no obvious hindrance to continued growth in that manner, the kidney shape will be accentuated, thus bringing the hæmel margins together and forming the characteristic *choroid fissure* of Vertebrates. (3) Such a view implies that the ancestral optic ganglion of Vertebrates is not a part of the retina, as is often assumed to be the case, but a series of ganglionic lobes similar to those belonging to the compound eyes of arthropods.

In insects where the ganglion is beautifully developed it usually consists of three great lobes: (1) a central one the largest, and shaped like a thick hemispherical shell, in fact, having much the same shape as the compound eye itself; (2) a thick semicircular band extending along its whole distal margin (the retinal ganglion); and (3) a nearly spherical ganglion on its proximal side. The latter is united to the base of the fore-brain by a thick stalk, and each ganglion is united with its neighbor by decussating bundles of fibres. The medullary portion of each ganglion is mainly on the hæmal side, the ganglion cells on the dorsal. In *Limulus* we have just such a set of optic ganglia, and in the embryos they project far away from the fore-brain and at right angles to it, as in nearly all other arthropods; but they gradually move backwards toward the wide dorsal line till in the adult crab they lie jammed close together on the hæmal side of the fore-brain near the median line.

Now if the migration of the optic ganglia of *Limulus* should continue in the same direction they would cross the median line and, following the path of least resistance, move in opposite directions towards the open space just behind the cerebral hemispheres.

As the proximal end of the ganglion stalk is fixed to the sides of the fore-brain, the ganglion would be bent double so that the stalk and optic nerve would lie parallel and side by side. The whole ganglion would now form the roof and sides of the mid-brain, and would reverse the direction of its curvature to fit its new position, thus effectively disguising its true character. The ganglion by its change in position is partly inverted, turning the ganglion cell layer toward the ventricle and the medullary portion toward the outside, just as the theory demands. In this position the retinal or most distal ganglion becomes the torus longus, the hemispherical one the tectum opticum, the third one the colliculus; the stalk or proximal end of the ganglion becomes the brachia, and probably such other tracts as unite the various lobes with the thalamencephalon; the crossed nerves form the chiasma and the optic tracts, the fibres in both cases entering what is morphologically the distal end of the series of ganglia, *i. e.*, the torus longus and its vicinity. (4) The commissural

systems support such a comparison. *Limulus* has in each ventral ganglion two sets of transverse commissures, four or five bundles below the remnant of the median furrow, and two above it. Thus a rudimentary '*canalis centralis*' is formed in the *adult* with commissures on either side of it. The entire set of neural commissures in the hind-brain of *Limulus* probably represent the beginnings of the cerebellum. In the fore-brain region of *Limulus* are three main systems of commissures, having the same general relation to the brain that the superior, middle and inferior commissures have in Vertebrates.

Life History and Sexual Relations of the Entoconchidæ. N. R. HARRINGTON.

The *Entoconchidæ* are a very rare degenerate type of molluscs, first observed by Johannes Müller. Since that observation, in 1852, but one contribution to their morphology has appeared. From the discovery of a new genus of this family, living under new conditions, the following facts may be observed:

1. Ontogenetically these forms do not pass through a Thyca or Stilifer stage, as has been suggested by recent hypothesis. They are ejected through the cloacal wall (as are the Cuvierian organs), or else are eviscerated, escaping from the sac by dehiscence.

2. The larva is free swimming and enters the new host with the water taken into the respiratory system, penetrating either the walls of the latter or those of the alimentary tract.

3. The adult sac is produced by the enormous outgrowth of the genital organs and subsequent degeneration of head parts.

4. For the first time in these degenerate shelless molluscs, separate sexes are observed. The males carry spermatophores. This observation takes *Entoconcha* from the evidence employed to show that Hermaphroditism is simpler and more primitive than Gonochorism in the Mollusca.

Budding in Clavilinidæ. G. LEFEVRE.

The only genera of this family of compound Ascidians whose bud development has hitherto been described are *Clavilina* and *Perophora*, but the following is a brief account of the process as it occurs in another genus, *Ecteinascidia*. The material was obtained in Jamaica and belongs to the species *E. turbinata*, Herdman. Although in external appearance the zooids resemble those of *Clavalina*, as they are quite elongated and the two siphons are at the anterior end, the species shows a closer similarity to *Perophora*, both in the structure of the adults and the mode of development of the buds. It differs from the former and agrees with the latter in the total absence of an epicardium and abdomen, but is distinguished from these two forms by the presence of perfect internal longitudinal bars in the wall of the branchial sac. There is nothing like the displacement or rotation of the inner vesicle of the bud rudiment, which has been described for *Perophora*.

The ectoderm of the bud is directly derived from that of the stolon and the inner, or 'endodermal,' vesicle from the stolonic septum, which, however, is not a flat partition, but a tube enclosed within the ectoderm and bathed on all sides by the blood. The bud is connected with the stolon at its posterior end, and its long axis is perpendicular to that of the stolen, as in *Clavelina*.

The pericardium is usually the first organ to appear, and is formed by cells which wander out from the wall of the inner vesicle far back on the right side.

The dorsal tube has a similar origin, but arises at the extreme anterior end of the vesicle, while the ganglion is differentiated out of the dorsal wall of the tube.

The sexual organs are also formed from cells which are given off from the wall of

the inner vesicle, but near the point where the digestive tract is growing out.

It is quite probable that free cells of the blood also take part in the formation of all these organs, as appearances strongly indicate such an occurrence, but these cells themselves are derived from the inner vesicle, which is clearly seen to give them off into the body space, especially at very early stages.

The ectoderm, therefore, is not actively concerned in the bud development, but the duty of providing the material for the formation of all the internal organs devolves solely upon the inner or 'endodermal' vesicle.

Notes on the Structure and Development of the Type of a New Family of so-called Social Ascidians from the Coast of Califoinia. W. E. Ritter.

In its superficial characters the new form closely resembles *Clavelina*. Studied in detail, however, its affinities are found to be much closer with the *Polyclinidæ*, *e. g.*, with the genus *Amaroucium*, than with *Clavelina*. The acidiozoids are wholly distinct from one another, excepting for their attachment to a common basal stolon, as in *Clavelina*, and in form, size and color they closely resemble the zooids of some species of this genus, *e. g.*, *C. savigniana* M. Edw.

They are flute-shaped, the attachment being at the small end. Their average length is about 3 cm. The colonies usually contain many zoöids closely crowded together, as in *Clavelina*. But beyond this the distinctively clavelinian characters cease. The general features of the individual zoöids are distinctly those of the *Polyclinidæ*. The body is divided into three well-defined regions: viz, the thorax, containing the branchial sac; the abdomen, composed mainly of the intestine; and the post-abdomen, containing the gonads and the heart.

In *Clavelina*, on the other hand, the gonads are situated within the intestinal loop, and the heart along side of it—in other words, *Clavelina has no post-abdomen.*

Now it will be noted that the *Polyclinidæ* are entirely typicical ascidiæ compositæ; *i. e.*, not only does reproduction by gemmation take place, but the blastozoids thus produced become closely crowded together and all wholly embedded in a common testicular mass.

This brief comparison will suffice to call attention to the fact, which becomes much more striking when the comparison is carried out in detail, that in the new form we have an ascidian which *in the relation of the blastozoides to one another in the colony is strictly a so-called social ascidian, while in the structure of the individual zoöids it is as strictly a compound ascidian.*

Another illustration is thus produced of the artificialty of a classification of the tunicata which attempts to base primary subdivisions on the condition of the blastozoides of the colony as regards a common test-mass.

The characters which prevent the form from being admitted to the family *Polyclinidæ*, and make necessary the establishment of a new one for it, are founded in the structure of the gonads and the oviduct; the relations of the epicardiac tubes; and in the arrangement of the branchial tentacles.

The study of the embryology is still quite incomplete. The embryos are developed in a long expanded proximal portion of the oviduct which may properly be called a uterus. About a dozen embryos are found in each uterus, these being placed in a single row, usually with the oldest farthest forward and the youngest nearest the ovary, or farthest back.

The larval stage is much abridged, the metamorphosis of the nervous system being nearly complete before the larva leaves the parent. It is doubtful if there is any free-swimming tadpole stage at all.

Numerous amœboid cells are always present in the uterus among the embryos. These are probably concerned in the nutrition of the embryos, since they may be seen passing through the uterine wall, and the uterus is surrounded by a great quantity of cells filled with yellow granules, probably of food material.

Perhaps the most important developmental point thus far made out is that the peribranchial sacs *arise as two well defined ectodermal invaginations on the dorsal side of the embryo.*

The results, then, support the conclusions of Kowalevsky, Seeliger, Willey, Hjort and Caullery on this head, and oppose those of Della Valle, van Beneden et Julin, Pizon and Garstang, who hold, in one way and another, that these structures arise from the endoderm.

Notes on Chelyosoma productum, Stimpson. F. W. BANCROFT.

An examination of about 20 individuals in the collections of the University of California shows that this western ascidian is quite distinct from its Atlantic and Arctic representative, *C. macleayanum.* Stimpson describes the species as having the disk, which is characteristic of the genus, divided into fourteen plates; but in the individuals examined the number was found to vary from thirteen to twenty. This variability is associated with a muscular system that is quite different from what is found in the other member of the genus. In *C. productum* the systems of short muscles joining adjacent plates are wanting, except around the orifices, and are replaced by a series of fibres extending from near the center of the disk to its periphery and some distance down the sides of the animal. The method of attachment of these muscles is different from that described for any other ascidian. Both ends of every bundle of muscle fibres are firmly attached to little projections of the inner surface of the test. On these the ectoderm is thrown into deep folds and pockets which greatly increase the surface of contact with the test, so that the muscles which are joined to the inner ends of the ectoderm cells cannot tear them away.

The matrix of the test, like that of some other tunicates, consists of an inner layer of cellulose and an outer one, very distinctly separated from it, which is not cellulose, and which corresponds to the 'yellow layer' of the early authors. In our species it is easily seen that this outer layer is formed from the cellulose matrix by the activity of the mesodermic bladder cells which the latter contains. The first traces of the 'yellow substance' are seen about isolated bladder cells near the outer layer, and all transitions can be traced from this stage until the cell and the yellow substance it has produced are incorporated into the outer layer. The other organs of *Chelyosoma* are of a less exceptional character and clearly show that it is more closely related to *Corella* than to any other genus.

On the Plan of Development of a Myxinoid. BASHFORD DEAN.

The marked dissimilarity in the development of Bdellostoma and Petromyzon was noted. In the former a large supply of yolk produces a merocytic condition at a very early stage; The head region of the embryo, appearing first, very much as in Elasmobranchs, takes its position near the animal pole; the body region is then laid down, apparently by concrescence, in an almost straight line extending in the direction of the yolk pole almost the entire length of the egg. The subsequent growth of the embryo constricts both head and tail from the yolk sac, and in very late stages an embryo of nearly two inches lies coiled within the egg A preliminary study confirms Professor Price's observations as to the great number of gill slits.

On the Early Development of Chimæra. Bashford Dean.

Emphasis was laid on the similarity of the embryonic characters of Chimeroid and Elasmobranch.

Amphiuma and the Cœcilians. J. S. Kingsley.

The various statements which had been advanced to show the relationships of *Amphiuma* and *Cœcilians* were considered, and it was pointed out that these statements were almost entirely based upon misinterpretation or misconception. The differences between the two were then emphasized, and it was shown that the structural features were opposed to the view of Cope that the Cœcilians had descended from an Amphiuma-like form, and to that of the Sarasins that *Amphiuma* was a neoteric Cœcilian. In the possession of an ethmoid, in structure of vertebræ, in the relations of palatine and trigeminal nerves, in structure of nephridia and genitalia and in circulatory apparatus, the Cœcilians differ from *Amphiuma* and from all Urodeles, and the group must be regarded as entirely distinct from Urodeles, and as having descended directly from some Stegocephalan ancestor.

Vertebral Intercalation in Necturus. (Read by title.) H. C. Bumpus.

Brachial and Lumbo-sacral Plexi in Necturus. F. C. Waite.

In *Necturus maculosus* the normal position of the pelvic girdle is with attachment to the 19th vertebra, but in about one-fourth the cases it is attached to the 20th vertebra. Unfrequent cases are found in which the attachment is asymmetrical, the sacral rib on one side being one segment anterior to that on the other side.

Study of the plexi in a series of specimens shows: (*a*) that the position of the brachial plexus does not vary with displacement of pelvic girdle, and so it is improbable that intercalation of vertebræ occurs anterior to the posterior spinal nerve (V) involved in this plexus; (*b*) with normal position of pelvic girdle there are two prevalent types of topography of the lumbo-sacral plexus which depend upon the manner of branching of the spinal nerves to form the crural nerve, and further that there is considerable variation in the strength of the nerves involved, causing a shifting within narrow limits of the 'source center' of the plexus. (*c*) When the girdle is attached to 20th vertebra the plexus shows a displacement posteriorly, but not in a corresponding degree through an entire segment. It thus occupies a position intermediate between the normal position and what would be its position were it displaced through an entire segment. (*d*) Where the girdle is attached asymmetrically the plexus does not show corresponding asymmetry, but is essentially symmetrical in one of the two segments involved.

The intermediate position of the plexus, the occurrence of symmetrical variation in position of girdle; of asymmetrically placed girdles and of supernumerary sacral ribs, appears to be explicable not upon ground of intercalation of vertebra nor of slipping of girdle during ontogeny, but upon the hypothesis that there are several segments in this region, in any one of which a girdle may be developed.

Discovery of a Huge Octopus on the Coast of Florida. A. E. Verrill.

The following officers were elected: President, C. S. Minot, Harvard; Vice-President, S. I. Smith, Yale; Secretary-Treasurer, G. H. Parker, Harvard; Members of the Executive Committee from the Society at large, J. S. Kingsley, Tufts, and Bashford Dean, Columbia.

G. H. Parker,
Harvard University. *Secretary.*

CURRENT NOTES ON PHYSIOGRAPHY.

CAMPBELL ON DRAINAGE MODIFICATIONS.

THE processes whereby rivers re-arrange their courses when the region that they drain is affected by gentle deformation is thoroughly treated by M. R. Campbell (Chicago Journ. Geol., IV., 1896, 567–581, 657–678). He gives a detailed deductive consideration of expected changes, leading to the 'law of the migration of divides;' in brief, that divides migrate towards an axis of uplift. It is further shown that, under the influence of tilting, rivers will, by the migration of divides, tend to arrange themselves in rectangular pattern, the smaller streams running down the dip, the larger along the strike of the tilt. Streams are most sensitive to these influences in their old age, when, by long striving, each individual has come to be so delicately balanced against its neighbors that the least outside influence may cause predatory conquests by the more favored. Several examples are given of rivers in the Appalachian region which appear to have been affected by changes of the kind here discussed; among these the Chattahoochee, New and Roanoke rivers being especially interesting.

To the student of the natural history of rivers this discussion by Campbell must be particularly acceptable, inasmuch as it introduces the competent consideration of an element of disturbance not sufficiently attended to in earlier studies of the development of river courses.

RUSSELL'S GLACIERS OF NORTH AMERICA.

UNDER the above title Professor I. C. Russell has prepared another 'reading lessons for students of geography and geology' (Ginn & Co., Boston, 1897), a companion to his Lakes of North America, and has thereby placed teachers and students alike under many obligations to him. Good geographical literature, neither in text-books nor in advanced professional reports, but in accessible and attractive form for ready use, is so rare that teachers are often at a loss where to find it; and students who reach an impressible, interrogative attitude are perforce left unsupplied with answers to their questions. It is only as books like these 'lessons' of Russell's increase in number that the studious treatment of geography can flourish. This book on glaciers is doubly welcome at the present time of a growing interest in geographical science. We find first a general account of glaciers and of their modern and ancient action; then several chapters on the existing glaciers of various districts in North America, the brevity of the chapter on Canada pointing clearly to that district as most in need of further exploration. Closing chapters discuss climatic changes indicated by glaciers, why glaciers move, and the life history of a glacier; the latter being especially recommendable from its novelty and breadth of view. The book contains many excellent illustrations.

THE GOHNA LANDSLIP.

A REMARKABLE instance of foresight in averting disaster is found in an account of the Gohna landslip on a head branch of the Ganges, in the Garhwal Himalaya, and of the flood that followed on the overflow of the resulting lake, as published by the Public Works Department of the Government of India (Calcutta, 1896). The slip occurred in September, 1893, continuing three days with deafening noise, darkening the air with the dust from shattered rocks, and clogging the narrow valley with 800,000,000 tons of detritus. The fall descended about 4,000 feet, spreading about two miles along the valley and rising 850 feet above the former stream level. It resulted from the undercutting of strata that dipped into the valley, and hence should be classed with those slides that follow the erosion of narrow valleys in uplifted

masses; as such, being a characteristic of vigorous young mountains.

Careful study of the ground made it clear that no artificial discharge could be made for the rising lake. As the impending flood could not be controlled, every effort was made to insure the safety of the people in the valley below by timely warning of the disaster. A telegraph line was constructed from Hardwar, on the Ganges at the edge of the plains, to Gohna, 150 miles within the mountains. In April, 1894, August 15th was set as the probable date of the flood. A number of suspension bridges were dismantled and removed. Safety pillars were set up on the valley slopes, at intervals of half a mile, and at heights of from 50 to 200 feet above the ordinary river level, thus indicating the probable limit of the flood, above which there would be no danger.

The lake back of the dam grew to be four miles long and half a mile wide. At midnight of August 25th–26th, during a heavy rainfall, the flood began. In four hours the lake was reduced to two miles in length and quarter of a mile in breadth; 10,000,000,000 cubic feet of water were discharged, cutting down the barrier 390 feet; advancing at a rate of twenty miles an hour at first, and ten miles an hour further down the valley, sweeping away many miles of valley road, completely destroying two bridges that had been left standing, because of remonstrances from local authorities against their removal, and leaving no vestige of many villages and three considerable towns; yet so fully was the danger announced that not a single life was lost.

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CURRENT NOTES ON ANTHROPOLOGY.

THE AMERIQUE INDIANS.

There has lately appeared in Paris a book with the title 'L'Amerique a-t-elle droit sous ce nom à un nom indigène?' by M. Franciot-Legall.

The question discussed is one which at various periods has risen in the Congrès Internationale des Américanistes, and derives its origin from the fact that somewhere in Central America there has been known a native tribe with the name 'Ameriques;' and it was argued that Columbus in his fourth voyage met this tribe and from it his associates gave the name to the land, —not from Amerigo Vespucci, as the geographer Waldseemüller says, or, at least, independently of him.

Some have doubted that there was a tribe so-called, but their existence must be conceded. They have been met by explorers of the present day—by Mr. Crawford, for example. Their affinity and precise location have, however, not been stated. These points have been settled lately by M. Alph. Pinart, who, as he lately informed me, secured a vocabulary of their tongue and found it to be of the Lenca stock, and their present home to be in the State of Honduras.

30TH REPORT OF THE PEABODY INSTITUTE.

The last report of the Curator of this institution, Professor F. W. Putnam, shows it to be in a flourishing condition. Among the results of its field work are numerous specimens of chipped stones said by the Curator to be 'found in the glacial deposits of the Delaware Valley,' about the age of which deposits it is fair to say geologists are not agreed.

Mr. Gordon's researches in Copan are referred to, and the fact emphasized that the establishment of that city was far more ancient than the surface ruins and standing monuments.

The report closes with some excellent suggestions for a course of instruction in anthropology, comprising a group of studies some acquaintance with which is essential to

an anthropologist. It necessarily includes several departments, but in a period of three years a diligent student could be qualified for original research.

PLIOCENE MAN IN BRITAIN.

GEOLOGICAL readers are aware that the Cromer Forest Beds of eastern England are to be assigned to either the latest Pliocene or oldest Pleistocene. They are distinctly preglacial and contain remains of a subtropical fauna.

From an article in *Natural Science*, for January, it appears that Mr. W. J. Lewis Abbott has collected from these beds a series of chipped flints bearing 'a striking resemblance to the work of man,' and have been pronounced to be such by competent experts. One showed a plain 'bulb of percussion.'

As there seems no doubt about their deposition with the original strata, the only question remaining is their production, whether by the hand of man or natural agencies. There still remains some doubt even as to the flints from the plateau of Kent on this vital point.

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UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

ON January 11th Professor Clemens Winkler, of Freiberg, delivered an address before the Deutsche Chemische Gesellschaft on The Discovery of New Elements during the last twenty-five years and problems connected therewith. He first considered the quantitative distribution of the elements, showing by Professor F. W. Clarke's tables that as far as concerns the outer ten miles of the earth, together with the atmosphere, one-half of all the material is oxygen, and one-quarter is silicon, and that these two elements, with aluminum, iron, calcium, magnesium, sodium and potassium make up over 7.5 per cent. None of the remaining elements occur in as great abundance as one per cent. In the process of cooling of the earth, and subsequent geologic action, many of the less abundant elements have become somewhat localized or concentrated; as, for example, chlorin in the sea and in salt deposits, the heavy metals in veins and lodes. Were this not the case many of the rarer elements must have escaped detection. An instance of this is scandium, discovered by Nilson in 1879, of whose oxid but a few grams exist. This element, and gallium, discovered by Lecoq de Boisbaudran in 1875, and germanium, discovered by Prof. Winkler himself in 1886, possess a peculiar interest, in that the properties of each had been quite accurately predicted by Mendeléef in 1871. Their discovery was a complete confirmation of the principles of the periodic law. The mineral gadolinite, with others closely kin, has been a fertile source of investigation, and the list of 'rare earths' that have been discovered in it is apparently by no means complete. Erbium, holmium, thulium, dysprosium, terbium, gadolinum, samarium, decipium and ytterbium have been discovered by various observers, but the independent existence of several of these is far from certain. Of several supposed new elements the non-existence is more sure; such are metacerium, russium, jargonium, austrium, norwegium, actinium, idumium and masrium. The same may, perhaps, be said of the recently *patented* lucium, kosmium and neokosmium. (These last do not derive their appellation from *kosmos*, but from Kosmann, their discoverer and patentee!). Work by Auer von Welsbach on his incandescent light led him to the decomposition of didymium into neodymium and praseodymium, whose beautiful red and green salts were well shown at the Chicago Exposition. The last elements considered by Professor Winkler were argon and helium. These apparently do not as yet fall into

harmony with the periodic system. The same may be said of tellurium and cobalt or nickel. Whether some or all of these elements are mixtures or whether their seemingly anomalous atomic weights must be explained in some other way does not as yet appear.

The action of the silent electric discharge in effecting chemical synthesis is being studied by Losanitsch and Jovitschitsch at the Königliche Hochschule at Belgrade. The apparatus used is an ordinary ozonizator, or, as they prefer to call it, electrizator. Mixed gases are led through the apparatus, exposed to the discharge of a Ruhmkorff excited by a current of 70 volts and three to five amperes. Carbon monoxid and water, also carbon dioxid and hydrogen, are condensed to formic acid; carbon dioxid and water yield formic acid and free oxygen; carbon monoxid and hydrogen give formaldehyde, which quickly polymerizes, apparently to a polymer glycolaldehyde. Carbon dioxid and methane condense to acetaldehyde, which soon forms aldol. A general method for formation of aldehydes is thus presented. Nitrogen and water condense directly to ammonium nitrite, a fact known to Berthelot, and considered to have a bearing on plant nourishment. Other interesting syntheses were obtained with sulfur compounds and with ammonia. In general, the reactions seem to be rather the reverse of those produced by heat.

The December *Zeitschrift für physikalische Chemie* contains a study by Paul and Krönig on the behavior of bacteria towards solutions of different salts. All salts of the same metal do not have the same germicidal effect upon the spores of the anthrax bacillus used for most of the experiments. Thus mercuric chlorid is more deadly than mercuric cyanid. Apparently those solutions containing the largest number of free ions of a metal possessing a specific poisonous character are most active. Mercuric chlorid is more completely dissociated in solution than the cyanid. Alkaline chlorids are often used to promote the solution of mercuric chlorid, but they also decrease the antiseptic power of the solution, since they diminish the dissociation and hence decrease the number of free mercuric ions. Dissolved in alcohol, mercuric chlorid has practically no effect on anthrax spores.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

REVUE DE MÉCANIQUE.*

A notable addition to the list of technical journals has been made in the establishment of this monthly. Its editors, Messieurs Haton, Bienaymé, Bourdon, Brüll, Collignon, De Comberousse, Flamant, Hirsch, Imbs, Linder, Raffard, Rozé, Sauvage, and the responsible collaborateur, Richard, all stand among the foremost men of applied science and engineering of France. They include the distinguished head of the École des Mines, member of the Institute, the inspector-general of the navy, a famous inventor and constructor, a past-President of the French Society of Civil Engineers, two inspectors-general of roads and bridges, two professors at the Conservatoire des Arts et Metiers, the engineer-in-chief of *ponts et chaussées*, upon whom the French government is accustomed to rely for advice respecting all its public works and especially at its international exhibitions, the inspector-general of mines, and the engineer-in-chief, and also a representative of the École Polytechnique.

This first volume opens with a prospectus indicating the scope of the plans of the editors and the field to be occupied by the new journal. The leading article is an extensive paper, sixteen pages, by M. Dwelshanvers-Dery, of the University of Liege; *Détermination des données fondamentales dans un essai de Machine à Vapeur*, in which the famous author gives, in full detail, the

* *Publiée sous le Patronage et le Direction technique d'un Comité de Rédaction, composé de* MM. Haton de la Goupillière, etc.; *Secrétaire de Rédaction*, G. Richard. Paris, P. Vicq-Dunod et Cie. Tome I., No. 1, Janvier, 1897.

methods employed by him in the analysis of the action of steam within the engine, and in the measurement of the heat and steam passing through its cylinder and in the determination of their various directions of useful application or of waste. This method is, in the main, that of Hirn, but reduced to algebraic expression by Dwelshauvers, and given application in scientific work of vastly more exact nature than was practicable in the time of the great master. The 'experimental engine' established within a few years at the School of Mines of the University of Liege affords M. Dwelshauvers opportunity to illustrate the principles enunciated and to secure original and helpful data, while, at the same time, giving practical instruction to his students.

A paper by M. Boulvin, of the University of Ghent, on 'Le Diagramme entropique et ses applications' follows. This diagram and method of representation of thermodynamic operations, original with our own Professor Gibbs, nearly a quarter of a century ago, is just attracting attention among scientific practitioners in engineering by its peculiar adaptation to the exposition of the effects of transformations upon the relative volumes of fluids, losing or gaining heat while work is being done. The pressure-volume diagram is usually better adapted to the needs of the engineer; but this special form of chart, the temperature-entropy diagram, better exhibits the physical condition of the fluid during the progress of the engine cycle. M. Boulvin, in his article, shows its practical uses, as particularly applied to the study of the permanent gases used as working substances in heat engines.

M. Sauvage studies the compound locomotive engine, exhibiting the structure of the principal classes in great detail and giving much attention to the forms familiar in the United States. M. Richard similarly discusses the refrigerating machines, giving detailed descriptions of the principal parts of such apparatus and according large space to those observed by him at the Chicago Exhibition of 1893. The same prolific pen offers an account of the construction of the later forms of the gas and petroleum engines. A 'chronicle' of current novelties and a review of contemporary literature conclude the volume, which occupies 112 giant pages.

With such extraordinary editorial support, and with such contributors, the new journal should promptly assume a place among the leading periodicals of its class; in fact, it may be said to have done so with this first issue.

The following original papers are announced as in preparation for succeeding numbers: L'Influence des parois dans les machines à vapeur, par Bryan Donkin; Le Surchauffe, par M. Sinigaglia; La Machine à vapeur américaine, par M. Thurston; Las Machines à vapeur marines, par M. Roche; Les Chaudiéres, par M. Walkenauer; Les Pompes, par M. Masse; Les Régulateurs, per M. Marie; Les Appareils de levage, Les Machines-outils, par M. Richard.

GENERAL.

MR. J. H. BRIGHAM, of Ohio, has been appointed Assistant Secretary of Agriculture.

THE fourth session of the Congress of American Physicians and Surgeons will be held at Washington, D. C., on May 4th, 5th and 6th, under the presidency of Professor W. H. Welch, of Johns Hopkins University. Fourteen of the most important medical societies, including the Physiological Society and the Society of Anatomists, will take part in the Congress. One of the three general meetings will be devoted to a discussion of 'Internal Secretions considered in their Physiological, Pathological and Clinical Aspects.' Dr. William H. Howell, of Baltimore, Md., and Dr. Russell H. Chittenden, of New Haven, Conn., will speak in behalf of the American Physiological Society. Dr. J. George Adami, of Montreal, Canada; Dr. James J. Putnam, of Boston, Mass., and Dr. Francis P. Kinnicutt, of New York City, in behalf of the Association of American Physicians, and Dr. William Osler, of Baltimore, Md., in behalf of the American Pediatric Society. The papers will be followed by a discussion.

THE anniversary meeting of the Geological Society of London was held at Burlington-house on February 17th. The officers were appointed as follows: President, Dr. Henry Hicks, F. R. S.; Vice-Presidents, Professor T. G. Bonney, F. R. S.; Lieutenant-General C. A. M'Mahon, Mr. J. J. H. Teall, F. R. S., and Dr.

Henry Woodward, F. R. S.; Secretaries, Mr. J. E. Marr, F. R. S., and Mr. R. S. Barries; Foreign Secretary, Sir John Evans, F. R. S.; Treasurer, Dr. W. T. Blanford, F. R. S.. The following awards of medals and funds were made: The Wollaston medal to Mr. W. H. Hudleston, F. R. S.; the Murchison medal and part of the fund to Mr. Horace B. Woodward, F. R. S.; the Lyell medal and part of the fund to Dr. G. J. Hinde, F. R. S.; the Bigsby medal to Mr. Clement Reid; the balance of the proceeds of the Wollaston fund to Mr. F. A. Bather; the balance of the proceeds of the Murchison fund to Mr. S. S. Buckman; the balance of the proceeds of the Lyell fund to Mr. W. J. Lewis Abbott and Mr. J. Lomas. The President delivered his anniversary address, which dealt with some recent evidence bearing on the geological and biological history of early Cambrian and pre-Cambrian times.

THE Council of the Royal Photographic Society of Great Britain have awarded the progress medal of the Society to Professor Gabriel Lippmann, of Paris, for his discovery of the process of producing photographs in natural colors by the interference method.

A SELECT committee of the British House of Commons has been appointed to inquire into and report upon the sufficiency of the law relating to the keeping, selling, using and conveying of petroleum and other inflammable liquids, and the precautions to be adopted for the prevention of accidents with petroleum lamps.

THE Supreme Court of the State of Wisconsin has declared compulsory vaccination to be unconstitutional on the grounds that it may be objected to as a matter of conscience and its enforcement would be an interference with religious liberty.

THE Council of the Sanitary Institute of Great Britain have accepted an invitation of the City Council of Leeds to hold a sanitary congress and health exhibition in that city in September.

THE Senate has passed a joint resolution reciting the alarming spread of the bubonic plague now prevalent in India, and directing the Secretary of the Treasury to establish such national quarantine regulations as may become necessary to prevent the introduction and spread of infectious or contagious diseases. The resolution provides for the appointment of inspectors by the Secretary of the Treasury, on the advice of the surgeon-general of the Marine Hospital service, and for the inspection of vessels, persons, etc., pending the existence of the emergency.

The British Medical Journal states that a careful and comprehensive report on the progress of public hygiene in Prussia during the years 1889, 1890 and 1891 is being circulated by the Medical Board of the Prussian Cultus-Ministerium (Ministry of Education, etc.). It is a book of more than 600 pages, comprising chapters on every branch of public health and on epidemics in man and beast, besides a large number of statistical tables. The latter include general mortality, mortality at different ages, mortality from different specified diseases, and disease and mortality in different trades. The problems of water supply and drainage, police supervision of food and drink, supervision of factories and schools, etc., are fully discussed, and there are chapters on workmen's dwellings, working colonies, poorhouses, almshouses, hospitals, etc.

PROFESSOR W. M. SPAULDING writes us of the death of Lorenzo N. Johnson, formerly instructor of botany in the University of Michigan, which occurred at Boulder, Colorado, Saturday, February 27th. "Mr. Johnson was an enthusiastic student of algæ and fungi and had devoted much time to systemmatic work on the Desmidiaceæ. He was the author of various papers on this group and had much extended their known range in the United States."

WE regret also to record the death of Mr. John Pierce, formerly professor of chemistry in Brown University, and of Professor Edward Thomson Nelson, of the chair of science in Ohio Wesleyan University, on February 28th.

AT the instance of the Commission on Bird Protection of the American Ornithologists' Union, the Lighthouse Board at Washington has issued a decree forbidding the sale of eggs of the sea birds of Farrallones Islands, California. It is said that as many as 20,000 dozen eggs were annually sold.

ACCORDING to the *Electrical World*, on June 26th next an exhibition will be opened in the

Exhibition Building, Sydney, N. S. W., and will continue during the months of July and August. It is intended to embrace engineering in all its branches, and the exhibits will consist of raw material, manufactured articles, machinery and models (in motion and otherwise), drawings and photographs of all kinds relative to scientific, mechanical and educational works, in classified sections. The object of the exhibition is solely for the advancement of engineering science and the promotion of a general and practical education therein.

IT is stated in the daily papers that what appears to be a volcano has burst forth in the Great Salt Lake, a short distance southwest of Promontory Station on the Central Pacific Railway. The phenomenon first appeared recently in the form of a small cloud hovering over the water about a mile and a quarter from the shore. It gradually increased in dimensions and shotup so high in the air that it is now visible for a great distance, and the water in the immediate vicinity boils and seethes and the spray is thrown up in the air for hundreds of feet.

AT a recent meeting of the executive committee of the National Trust for Places of Historic Interest or Natural Beauty, Sir Robert Hunter in the chair, it was determined to take steps to initiate a regional survey of the country, and, by means of local correspondents, initiate the compilation of a catalogue of buildings, objects and places of historic and archæological interest, with a view to their proper protection and preservation. A report by the Treasurer showed that the work of repairing and making sound the old clergy-house at Alfriston (which has recently been acquired by the Trust) had had to be suspended on account of lack of funds, a sum of £200 being still needed. It was announced that the transfer of Barras Head, opposite Tintagel Castle (which has recently been acquired by the Trust) was complete. The committee were unanimous in agreeing to resist the Hastings Habour District Railway Bill on the ground of its serious interference with features of natural beauty in the district.

IT is stated in *Nature* the government of the Colony of the Cape of Good Hope has undertaken an investigation of the marine fauna of of the South African coast. A small marine station will probably be erected on False Bay, and a suitable steam vessel of about 150 tons is now being built for the station. The services of specialists are invited to work up the material that may be procured, under the following arrangements: Specimens will be forwarded as procured, and, on receipt of manuscript and drawings each piece of work will be published without delay in a uniform style, so as to form ultimately a complete record of the Cape marine fauna. Author's copies will be forwarded as soon as published, and a certain circulation will be guaranteed. No money remuneration is offered, but duplicate specimens may be retained by the authors. Unique specimens will be handed over to the South African Museum in Cape Town. Further information will be supplied on application to J. D. F. Gilchrist, Marine Biologist to Cape Government Agricultural Department, Cape Town.

WE have already noticed the return of Mr. J. E. S. Moore from his scientific expedition to Tanganyika. In conversation with a representative of Reuter's Agency Mr. Moore said that he left England in September, 1895, and proceeded to Chindi, thence going by a British gunboat to the north of Lake Nyasa. At Karongas he got together his caravan consisting of about 50 men, some of whom were armed with rifles. There was, however, no likelihood of difficulty with the natives. He then marched along the Stevenson Road to the south end of Tanganyika, where the Chartered Company placed at his disposal a steel boat. He commenced his researches in the beginning of April, 1896, and concluded in September. He found the fauna of Tanganyika to be unique—unlike anything else anywhere—and as limited as peculiar. The jellyfish and shrimps were certainly of a marine type while the geology of the district precluded the possibility of any connection with the sea in recent times. The water of this lake, which Livingstone found to be brackish, was now quite drinkable. All this seemed to prove that the Tanganyika part of the great rift valley running through that part of Africa at one time had access to the sea, while it was perfectly clear that Lake Nyasa,

some 246 miles to the southeast, apparently never had any marine connection. It was also a matter of interest that the fauna of Tanganyika was not only marine, but of a very peculiar and primitive type, and it was quite reasonable to suppose that the characteristics of the fauna were connected with the remote geological connection of the lake with the sea.

The first census of the Russian Empire was completed on February 9th. The work has been in preparation for several years past, being carried out with the aid of the statistical committees and the Imperial Geographical Society. The inevitable difficulties, due to the vastness of the Empire and the diversified character of the people, have been increased by their ignorance and superstition. They are said to fear not only fresh taxes, but also a re-introduction of serfdom.

Under the title 'Magnetic Declination in the United States,' the United States Geological Survey has just published a compilation and discussion of magnetic declination, by Mr. Henry Gannett, which will be of value to surveyors throughout the country. The compilation is based upon magnetic observations made at about 22,000 stations. All data obtainable for the discussion of the secular variation in declination have been used, and the results are presented in the form of tables, showing the approximate reduction to a selected epoch—namely, the year 1900—at each tenth year prior to that time for the period during which it may be required. Finally, the declination data have been reduced to this epoch, 1900, and are presented in the table by counties, cities and towns. The calculated distribution of the magnetic declination for the United States in 1900 is graphically exhibited upon a map in a pocket in the cover. W. F. M.

We have received from Dr. J. Milne an advance copy of a circular to be issued by the Seismological Investigation Committee of the British Association, asking cooperation in an endeavor to extend and systematize the observation of disturbances resulting from large earthquakes. The Committee recommend that similar instruments be used at all stations and are prepared to supply, for about £50, an instrument to those willing to forward to them notes of disturbances having an earthquake character, for analysis and comparisom with the records from other stations. From time to time the results of these examinations would be forwarded to each observatory. The first object in view is to determine the velocity with which motion is propagated round or possibly *through* our earth. To attain this, all that is required from a given station are the times at which various phases of motion are recorded; for which purpose, for the present at least, an instrument recording a single component of horizontal motion is sufficient. Other results which may be obtained from the proposed observations are numerous. The foci of submarine disturbances, such, for example, as those which from time to time have interfered with telegraph cables, may possibly be determined, and new light thrown upon changes taking place in ocean beds. The records throw light upon certain classes of disturbances now and then noted in magnetometers and other instruments susceptible to slight movements, whilst local changes of level, some of which may have a diurnal character, may, under certain conditions, become apparent. Those willing to cooperate in this important investigation should address The Seismological Committee, British Association, Burlington House, London, W.

UNIVERSITY AND EDUCATIONAL NEWS.

The faculty of Mt. Holyoke College announce the gift to the College of $40,000 for a dormitory by Mr. John D. Rockefeller, of New York, and the receipt of a check 'from a friend' for $2,250.

Some months ago it was announced in Science (August 7, 1896) that the University of Texas, through the liberality of Hon. George W. Brackenridge, of San Antonio, a member of the Board of Regents, had come into the possession of the finest collection of recent shells west of the Mississippi. We now have the pleasure of recording a supplementary gift from the same generous donor consisting of the Galveston Deep Well Collection, numbering 102 species; a collection of Eocene, Miocene and Pliocene fossils from California, Texas and other Southern States, 106 species; a collection

of Texas Carboniferous and Cretaceous fossils, 58 species, and 157 specimens of Texas flints (implements). This material was brought together by Mr. J. A. Singley, the well-known collector, now a resident of Giddings. In the mean time the library of the law department has been increased by the addition of nearly two hundred volumes, presented by Ex-Governor O. M. Roberts. The gift from the first professor of law is greatly appreciated. The largest donation, however, is that announced on February 23d. On the day preceding the Palm library, consisting of 25,000 volumes, the largest private collection in Texas and probably in the Southwest, was formerly turned over to the University by its owner, Mr. Swante Palm, of Austin. It contains many rare and costly volumes brought together from the great book centers of the world. 'The collection,' it is said, 'embraces not only general literature, history, biography, travels, science and philosophy, but also a remarkable collection of art books, illustrating ancient, medieval and modern art, custom and manners.' Mr. Palm is a native of Sweden and a resident of Texas for over fifty years. In 1883 he was knighted by King Oscar. The University library now contains over 40,000 volumes.

FREDERIC W. SIMONDS.

THE will of the late Anson Chapell, of West Hartford, Conn., leaves $3,000 to Washburn College, Topeka, Kans., and the same amount to the Hampton Normal and Agricultural Institute of Virginia.

AT the regular March meeting of the trustees of the New York University it was decided that the control of the University Medical College should be vested in the Council., The Medical College Laboratory, said to be worth $400,000, is transferred to the Council, which body will hereafter be responsible for the appointment of professors. Chancellor MacCracken announced at the meeting that the Building Committee had made a contract for the construction of the new library building at University Heights. The material used in construction will be grayish yellow Roman brick and Indiana limestone. The building will have a depth of 200 feet and will be 100 feet wide.

IT is reported that the investigation of the University of Wisconsin by a Legislative committee shows that the University has overdrawn its account at the State treasury to the amount of $145,944.76.

THE syndicate of the University of Cambridge appointed to consider the question of granting degrees to women has reported in favor of conferring the degrees of B.A. and M.A. under certain conditions, but against admitting women to membership in the University.

WE recently gave the percentages of hours devoted to different departments at Harvard and Yale Universities. The Boston *Transcript* has now published similar figures for Cornell University and the New York *Post* for Princeton University. While we cannot vouch for the accuracy of these figures they seem sufficiently interesting to deserve repetition.

	Harvard.	Cornell.	Yale.	Princeton.
Classics	8.7	8.0	24.2	22.6
European languages	22.8	18.8	14.5	12.4
English	16.8	16.3	10.9	11.3
Political science	9.9	6.5	11.2	9.6
History	14.3	8.2	10.4	
Mathematics	4.4	6.6	9.6	19.4
Philosophy	6.1	7.7	8.9	8.6
Natural science	10.2	23.5	8.1	8.8

It thus appears that Yale and Princeton agree somewhat closely in the distribution of studies, except for the excess in mathematics at Princeton. Harvard and Cornell also agree to a considerable extent, but Cornell devotes one-fourth of the entire time (the figures refer to the academic department) to science. It is noteworthy that in the Senior year at Princeton, when the studies become elective, only 3.8 per cent. of the time is given to the classical languages, and 15.1 per cent. to natural and physical sciences. The classical languages evidently only hold their position at Yale and Princeton through compulsion. European languages tend to take their place in large measure with some gains by English and the sciences.

IT is stated in the London *Times* that at a meeting of Edinburgh University Court it was reported that, in addition to the sum of £5,000, less legacy duty, bequeathed to the University in 1893 by the late Mr. A. L. Bruce, Edinburgh, towards the founding of a chair of pub-

lic health, a further donation of £1,063 for the same object had been intimated from Mrs. Bruce and other members of the family. It was also reported that an offer of £5,000 towards the same object had been received since last meeting of the Court from a gentleman whose name, at his own request, is not to be made known for the present. The Court, considering that the amount of donations approximates the sum which they think to be necessary for the endowment of the proposed chair, resolved to request the Universities' Commission to frame a draft ordinance instituting a separate chair of public health in the University.

Dr. Otto Fischer, professor of chemistry at the University at Erlangen, has been called to Kiel; Dr. W. Felix has been promoted to an associate professorship of anatomy at the University of Zurich. Dr. August Pauly has been made associate professor of comparative zoology at the University of Munich and director of the division of zoology at the forestry experiment station. Professor Pasquele Baccarini has been appointed professor of botany at the University of Catania and Dr. Oswald Kruch professor at the agricultural experiment station in Perugia.

DISCUSSION AND CORRESPONDENCE.

OPPORTUNITIES FOR TRAINING IN PHYSIOLOGY.

The department of physiology in the Harvard Medical School offers to four qualified men positions in which training in physiology may be obtained.

It is expected that these men will give the mornings of the collegiate year to research and the afternoons to the direction of undergraduate students in experimental physiology, under the supervision of a professor in the department.

Every effort will be made to instruct the holders of these positions in the ways of framing problems for investigation, in the principles of criticism, in the technical methods of research, and in the manner in which the results of an investigation should be put together for publication. Instruction will be given also in methods of teaching, including the arrangement of lectures, the division of subject-matter between the systematic course covering the entire field and the advanced special lectures, the physiological conference, the Journal Club, the use of the projection lantern in physiological demonstration, and the demonstration of physiological experiments to large and small classes.

The direction of laboratory work will be an important part of the training. The first year class in the Harvard Medical School is divided into sections of thirty-two. Each section works twenty-four afternoons in experimental physiology, making more than one hundred experiments, such as the influence of temperature on the form of the muscle curve, the phenomena of electrotonus, the compensatory pause of the heart, the use of the artificial eye, the ophthalmoscope, laryngoscope, sphygmograph, etc. etc. The repetition of fundamental experiments in this course, and the great variety afforded by so many experimenters working at the same time, secure to the directors of the work a thoroughness and a breadth of training in elementary physiology scarcely attainable in other ways.

The administration of a large department will be carefully explained. Attention will be given to the cost of apparatus for instruction and research, the problems of construction and maintenance of plant, the care of storage batteries, the making of lantern slides, the cataloguing of physiological literature, the importation of apparatus, and many other details essential to the successful operation of a physiological laboratory. Men intending to devote themselves to clinical medicine, will, of course, give less time to these things and will concern themselves chiefly with matters bearing directly on their chosen work.

It is evident that these appointments will afford an admirable training to those intending to make physiology or any other of the biological sciences a profession. To the physician they offer a training not less valuable in the opinion of those who believe that research in the fundamental sciences is the best introduction to the higher walks of medicine.

Applicants for these positions should possess an elementary knowledge of physiology and a sufficient training in one or more of the biological sciences to enable them to profit by the instruction offered. Successful applicants are

required to take twelve half-days' instruction in the details of the course in experimental physiology, before October 1st of their year of service.

No charge of any kind will be made for the year's training.

The Harvard Medical School will give successful applicants the title of 'Assistant in Physiology,' and for the direction of the classes in experimental physiology will pay each Assistant four hundred dollars.

Applications may be sent to

PROFESSOR H. P. BOWDITCH.
HARVARD MEDICAL SCHOOL, BOSTON, MASS.

NOTE ON NATRIX GROHAMII B. & G.

IN Professor O. P. Hays' report on the Batrachians and Reptiles of Indiana* he says, on p. 589, "The young are no doubt brought forth alive and active." There is now no question about the fact of their being viviparous, as several were born alive in the Chicago Academy of Sciences, July 29th.

The adult female, measuring 775 mm. in length, was collected at Glenn Ellyn, Illinois, on July 25th, by Mr. Frank M. Woodruff, and its extreme size was particularly noted; four days later it gave birth to eight young, which were alive and very active. The births took place some time during the night, and the young were noticed on the following morning a little after 7 o'clock. They were at that time fully active and resembled somewhat the parent, although differing in some of the color markings. The young measured 246 mm. in length and were colored as follows: Back slaty-blue with two very dark dorsal stripes; a dark stripe borders the edge of the blue dorsal surface and separates it from the yellowish lateral surface; this is in turn separated from the greenish-yellow ventral surface by a black stripe, which follows the edges of the plates in a zigzag manner and disappears on the side of the head.

The young were kept alive for several weeks and finally preserved, with the parent, in the Academy's collection (Mus. No. 10,337 adult; 10,335 young). As another point of interest we might mention that a specimen of the Western Bull Snake (*Pitnophis sayi Schleg*), measuring nine feet in length, laid twenty-two eggs in captivity during the first week in August. The female was in the same cage with a small male for about two months previous to the laying, and it is probable that copulation took place during captivity.

FRANK C. BAKER,
FRANK M. WOODRUFF.

* Indiana. Department of Geology and Natural Resources, 17th Annual Report, 1891.

PSEUDO-AURORA AGAIN.

IN SCIENCE, First Series, for December 2 and 16, 1892, there was a short discussion of this subject, and now appears a still longer letter on the same subject in SCIENCE for January 29, 1897. It seems a little strange that so simple a phenomenon should give rise to so diverse views, and yet when we consider how many views have been given of a precisely similar phenomenon, 'The Brooken Spectre,' it is not so surprising. It is probable that this latest description is given from memory and not from notes made at the time—an exceedingly important proceeding if one would keep from falling into grievous errors. Every electric arc light has a support at the top, and this would absolutely prevent any column of pure white light being projected toward the zenith. More than this, if these assumed horizontal planes of ice reflected the light it seems impossible to consider that the reflections would be only from a region directly above the lamp.

If one will turn to the description in SCIENCE, December 2, 1892, he will see how it is almost exactly contrary to this later one, and yet the former undoubtedly presents a better idea of the phenomenon. When the air is full of frost particles or fog any object standing before a light will cast a shadow into the mass of frost particles or fog. If one will stand underneath an arc light when the air has fog in it he will see what appears like a beam projected into the fog. The same may also be seen when any foot rest or projecting arm intercepts the light; in this case a horizontal beam will be seen passing into the fog. Just at sunset if one stands upon a broad plain with his back to the sun he will see his shadow cast upon the ground and extending more than 100 feet to the eastward. Now imagine the surface on which the shadows cast to be practically on all sides like fog; then

the shadow will be cast into the fog and appear gigantic. This is probably an explanation of the 'pseudo-aurora.'

H. A. Hazen.

January 29, 1897.

[The above letter entirely mistakes the point of Goode's explanation of the pseudo-aurora. The fact that the electric lights have shields above them, which cut off vertical rays, as stated by Hazen, is irrelevant; for Goode does not think that the apparently vertical pseudo-auroral rays are really vertical; but that they are due to oblique rays emitted from the light at various angles of inclination, and reflected from under surface of horizontal snow plates, so that the locus of the reflection stands in a vertical plane through the observer, and the light wherever the observer is; hence the subjective impression that the ray is really a vertical beam of light. There is no analogy between these apparently vertical illuminated rays and the true dark shadows mentioned by Hazen.—Ed. Science.]

GREENLAND GLACIERS.

To the Editor of Science: The angular and apparently unglaciated peaks in Greenland mentioned by Professor Tarr in your issue of to-day are represented in Pennsylvania by similarly angular ridges covered by angular and local débris. It seems that advancing ice has no power to surmount a moderately sharp slope, but masses at its base and accumulates till the summit is reached, when a thrust plane is developed in the glacier above which the moving mass proceeds across the summit. This has been noted by the writer (Am. Jour. Sci., March, 1895, p. 181) at Bethlehem and in Mifflin township. Since the publication of the above other instances have been found which show that the glacier pours into a valley and fills it, or masses against a steep, opposing slope, develops the shear and remains practically stagnant below the thrust plane, or would remain so were it not for its ablation and the erosion due to subglacial torrents, which cause it to settle *down* the slope and down the valley trough, and thus become an accentuated creep which strews the valley with local fragments from the summit. The constantly forming sub-glacial void, due to the causes just stated, induces a downward movement in the ice above the thrust plane, and the crest of the ridge is frequently found crushed by vertical forces. In the Mahanoy region the vertical outcrop of hard sandstone is thus crushed flat to a depth of ten feet on the crest, and bent to north on the northern slope and to the south on the opposite side. This is but one instance where valleys have been glaciated while the summits of the ridges remain angular, and the fact that there is always difficulty in tracing moraine lines over ridges may be accounted for by the fact that ridge deposits are not allowed to remain *in situ* but creep down the slopes to the valley troughs. The finding of angular ridges or peaks, therefore, is, as Professor Tarr states, no sign of the absence of ice from the locality.

Edward H. Williams, jr.

Lehigh University.

SCIENTIFIC LITERATURE.

L' evolution de l' esclavage. Par Ch. Letourneau. Paris, Vigot Frerès. 1897. 1 vol. 8vo. Pp. 538.

It is a sad fact, emphasized by Professor Letourneau, that in all times and places most of the work of the world has been imposed upon the minority of the inhabitants. In old times, and in some places to-day, this was accomplished by the simple means of brute force, reducing the conquered and the feeble to the condition of slavery. The development of this tendency in the past, and its possible future effects, are the theme of the work before us.

It begins with the lower species, pointing out that in the societies of ants and termites there are slaves and servile revolts, quite like those in human history. Among men of the inferior races—and not these only—the regular slave is the woman. In many of the negro peoples she is literally a beast of burden, and is rated no higher than one. The women are bought and sold; they are given away and, when incapable of further profitable labor, are killed and eaten, or turned out to starve.

The long list of examples of this character collected by our author leaves a disagreeable sense of the meaness and baseness of masculine

nature. It inevitably led, as he points out, to a degeneration both of the slave and the master, both of the woman and the man, and destroyed the possibility of any notable progress in civilization.

In the chapter on slavery among the American aborigines he adduces a few examples, but recognizes that it was not a prevalent institution with the red race. The gynocracy found in some tribes, he explains as merely apparent, not a real government, but confined to industrial aims. On the slaves of Mexico and Peru, he is somewhat full, but confines himself to second-hand authorities and not always the best of these.

From America he passes to the Polynesians and the Mongolians, where the condition of the enslaved classes was as wretched as anywhere. Turning to ancient history, he collects from classical authorities a mass of information on slavery among the Semites, the Egyptians, the Greeks and the Romans. Of course, on the latter he is particularly ample, as the sources of accurate knowledge are abundant. Everywhere he finds the same characteristics evolving in like social environments.

The semi-servile conditions in the Middle Ages, such as those of the serfs, the adscripts of the glebe, and the like feudal dispositions of the lower classes, occupy an instructive chapter.

Finally, the author applies himself to the practical application of his long study of enforced labor. How is it to be avoided? Or so modified as to distribute even taxes on all? To this he devotes his closing pages; but they are too vague, too visionary, too remote from any possible immediate adoption, to satisfy the earnest reader. Slavery, in its ancient forms, is practically extinct; but is not modern freedom, in the face of labor unions on the one hand and monopolies on the other, just what Dr. Johnson defined it a hundred years ago and more, freedom to work or starve? An excellent index closes the volume.

D. G. BRINTON.

The Geological and Natural History Survey of Minnesota. N. H. WINCHELL, State Geologist. 1892–1896. The Geology of Minnesota, Vol. III. Part II. of the Final Report. Paleontology, by E. O. Ulrich, John M. Clarke, Wilbur H. Scofield, and N. H. Winchell. 4to. Minneapolis, 1897. Pp. lxxxiii. to cliv., 475–1081, plates 35–82, and 133 figures in the text.

The introductory chapter by N. H. Winchell and E. O. Ulrich gives a detailed correlation of the Lower Silurian deposits of the Upper Mississippi province, with those in the Cincinnati, Tennessee, New York, and Canadian provinces, together with the stratigraphic and geographic distribution of the fossils. It is doubtful whether any State Survey has ever before attempted so successfully such a minute study and correlation of the beds and horizons of an extensive series of sediments. It shows a vast amount of careful and intelligent collecting. This kind of work has made possible the preparation of the succeeding excellent chapters on various classes of fossil remains from the Lower Silurian or Ordovician.

E. O. Ulrich, under separate chapters, treats of the Lamellibranchiata and Ostracoda. These classes of animals are generally recognized as difficult to deal with in the fossil state, the former from the common imperfection of preservation, and the latter from their minute size and simple form. The paleozoic lamellibranchs are arranged under twenty-nine families, of which ten will include all or nearly all of the Ordovician genera.

The Trilobites are described by J. M. Clarke, in Chapter VIII. The material is not so rich as in some of the other classes, but is thoroughly elaborated. Valuable sections are added dealing with the American Lower Silurian Phacopidæ, and the subordinate generic relations of the species of the genera *Ceraurus* and *Lichas*. Chapter IX. on the Cephalopoda is by the same author. About fifty species are noticed, including the novel primitive nautiloid type, *Nanno*, about which there has already been considerable discussion in America, England and Sweden.

The final chapter (X.) on the Gastropoda, by E. O. Ulrich and the late W. H. Scofield, occupies more than one-third of the volume. Numerous new genera and species are described and illustrated, showing the richness and variety of this fauna.

C. E. BEECHER.

Municipal Government in Continental Europe. Albert Shaw. New York, The Century Co. 1895. Pp. 505.

The energetic editor of the *Review of Reviews* has embodied in the volume before us the results of much persistent investigation. The facts so industriously collected are sure to be of great value to such of our American municipalities as are beginning to struggle towards the light. Whatever be one's opinion regarding the theory of municipal ownership of street railways, lighting plants, ship canals, etc., there can be no doubt that it is both useful and suggestive to have the facts derived from foreign experience made known to us. There will, moreover, be general agreement that we can profit largely by the varied experiments of European towns in municipal sanitation.

Mr. Shaw's attitude is at times, it must be confessed, one of breathless admiration. The phrases 'bold project,' 'splendid public work,' 'uniformly brilliant results,' punctuate descriptions of undertakings and 'achievements' at which many critics still shake their heads. Can it be, we find ourselves asking, that every municipality has solved its sanitary problems in just the right way? Must it not be admitted that not a few European towns are still in the thick of experiment, still groping towards a solution of difficult problems which beset them, still far from confident that the demands of the situation have been really met?

Paris, under the caption 'the typical modern city,' receives by far the most elaborate treatment at the hands of our author, and there will be little dissent, we fancy, from his explanation in the preface: "I can hardly think that any reader will fail to agree that Paris is the necessary starting point for a description of the modern régime in Continental cities." Here, as in the well-known companion volume, '*Municipal Government in Great Britain*,' already reviewed in this Journal, important questions of sanitation are treated as municipal problems of the first magnitude.

The double service of water supply devised for Paris by M. Belgrand is, perhaps, as Mr. Shaw appears ready to believe, theoretically admirable, but in practice it has not been found to work altogether smoothly. The supply of spring water has been almost always too scanty and the insufficient quantity has been eked out by the water of the polluted Seine. So well recognized is the injurious effect of the Seine water that warning is given through the public press when the river water is to be turned into the pipes, and when water from the Seine has been substituted for more than twenty days in the year the householder has the right to a reduction of rates. The water brought from a distance has, moreover, not proved all that could be desired. An epidemic of typhoid fever, which broke out in Paris in 1894, was traced by the authorities to the supply from the Vanne, in which full confidence had hitherto been placed. We are inclined to demur here at the encomiums bestowed by Mr. Shaw on the double system, and to believe that the day has not come when one may safely predict with him, "In due time * * * the double system will have been carried out in an ideal manner for all Paris." (p. 67.)

On p. 335 the statement occurs, during the admirable discussion of the functions of the German city, that "the quantity of water used by a city is regarded by British sanitary authorities as, in a rough way, a measure of its relative civilization." On this point we believe our author missed an admirable opportunity for pointing a moral, a kind of opportunity which, it must be said, he does not often allow to slip unheeded. The excessive quantity of water 'used' in the United Sates is not exactly an indication of our superiority in things sanitary. The disparity between the quantity of water per capita pumped into the mains in Europe and that supplied in the United States is, indeed, little to our credit, although no one will dispute Mr. Shaw's statement that "an abundant supply of pure water, thoroughly distributed, is a vital consideration for any city." While London gets along with 44 gallons a head daily, Hamburg with 58, Dresden with 22 and Berlin with 17, New York and Boston must have 92 gallons, Chicago 131, Philadelphia 162, Pittsburg 220 and Allegheny 247. It is well known that at least a partial remedy for this condition lies in the introduction of the meter and other devices, and yet this disgraceful waste of water is steadily increasing in most large American municipalities

despite the protests of responsible superintendents and engineers.

The methods of sewage disposal in use on the Continent are discussed in a generally accurate, though non-technical fashion. The Paris and Berlin sewage farms are described in course. The Gennevilliers irrigation fields in the sandy peninsula opposite St. Denis are not, as might perhaps be inferred from Mr. Shaw's statement, directly controlled by the municipality, but the individual occupants regulate at will the amount of sewage turned into the trenches. At Berlin the sewage farm system has achieved its most brilliant success. A great variety of crops is grown upon these farms; on one farm roses are cultivated for the purpose of manufacturing the perfume attar of roses.

The housing of the working classes deservedly receives a good deal of attention, particularly in connection with the author's study of the German cities, where the overcrowding is in some cases almost incredible. In Breslau in 1885 no fewer than 150,000 people out of a population of 287,000 lived in habitations containing only one room that could be warmed. In Berlin in 1890 the average number of inhabitants in a dwelling house (Grundstück) was 73 as against an average of 67 in 1885. The point is taken, however, that the German municipal authorities have the facts of the case well in hand and are trying to remedy the evil.

Our author notes here and there various interesting facts relating to the general sanitary oversight and organization in European towns. The control of food supplies, the supervision of abattoirs and the disinfection service all receive merited attention. Where so much is included it would be ungracious to remark the omission of some interesting and important topics.

The chapter on *Hamburg and its Sanitary Reforms* takes careful note of the wave of reform that has lately swept over the great port. The dearly-bought lesson of the cholera outbreak of 1892–'93 has not been thrown away, and the energetic administration of Dr. Dunbar and his staff of expert assistants has not only made a brilliant success of the attempt to purify the Elbe water, but has also wrought great improvement in the general sanitary condition of the city. The story is told by Mr. Shaw in his best vein. We trust, however, that the following statement: "In July, 1893, the imperial health authorities at Berlin issued a warning to the municipal governments of the country not to supply their citizens with a drinking water containing more than 100 *cholera* germs to the cubic centimeter" (p. 398), will not be taken as a literal transcript of the German decree. Mr. Shaw should have been told that all germs netted in the Elbe were not cholera germs.

EDWIN O. JORDAN.

SOCIETIES AND ACADEMIES.

TORREY BOTANICAL CLUB, JANUARY 27, 1897.

THE scientific program was as follows:

Dr. H. H. Rusby, 'Remarks on some Solanaceæ.'

Mr. A. A. Tyler, 'The Origin and Functions of Stipules.'

Dr. J. K. Small, '*Aster gracilis* Nuttall.'

Mr. George V. Nash, 'New and Noteworthy American Grasses.'

Dr. Rusby exhibited a number of Solanaceous plants and remarked upon their relationships. It was pointed out that the general appearance and chemical and physiological characteristics of these plants frequently fail to indicate their structural affinities. Cestrum and Sessea, Atropa and Datura were cited as illustrations of the separation of otherwise naturally related groups through their possession respectively of baccate and capsular fruits. Nicotiana was referred to as connecting those tribes having a radical symmetry with the tribe Salpiglossidæ, having a bilateral symmetry and thus connecting the family with the Labiales. The Androcera and Andropeda sections of the genus *Solanum* were instances of the appearance of this bilateral symmetry in a widely separated part of the family where radial symmetry is the otherwise invariable rule.

Dr. Britton discussed the subject and remarked upon this instance of development of two divisions of a group along different lines, in this case through baccate and capsular fruits. He cited similar parallelisms in other families tending to produce different resulting characters, as in *Capparidaceæ*, and remarked that an indication of the lines along which these genera

have been derived may be read in these characters.

The second paper by Mr. A. A. Tyler, on 'The Nature and Origin of Stipules,' presented conclusions derived from studies extending through several years. The subject was treated at length in the light of geological, morphological, anatomical and developmental evidence. Discussing Mr. Tyler's paper, which will shortly be published in full, Dr. Britton remarked that "the outcome of this very important paper is most interesting; it emphasizes the significance of basal scales and those of buds and rootstocks; and it is the more convincing from the nicety with which it accords with the seemingly haphazard distribution of stipules widely but irregularly here and there through the vegetable kingdom."

Mrs. Britton discussed the paper further, referring to the different phases presented in *Fissidens*.

Of the remaining papers, that by Mr. Nash was read by title and will appear in the *Bulletin*; and that by Dr. Small was, on account of the lateness of the hour, deferred till the next meeting.

Edward S. Burgess,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF ASTRONOMY AND PHYSICS, MARCH 1, 1897.

F. L. Tuffts presented an abstract of work recently done by him in further testing the correctness of the results obtained with the original form of the Rood flicker photometer. By a very elaborate series of tests by various methods, he found that the true 'flicker,' which appears when the speed is just sufficient to give a uniform background, is independent of color and depends only upon differences of luminosity.

The paper was discussed by R. S. Woodward and W. Hallock. W. Hallock described several forms of maximum thermometers used in subterranean temperature work, and described a new form which it is believed will obviate some of the difficulties of the U. S. signal service form, which has been used so successfully.

Mr. Hallock also reported upon recent work on subterranean temperatures referring especially to the Sperenberg well, near Berlin, 4,300 feet; the Wheeling, W. Va., well, 4,500 feet; the new Pittsburg well, 5,386 feet; the Schladebach well, near Leipzig, 5,740 feet, and the incomplete well at Paruschowitch, near Reibnik, which two years ago was 6,600 feet deep and was planned to go 2,700 meters (8,800 feet). The well at Pittsburg gave results practically identical with those obtained in the Wheeling well, which is forty miles distant but in practically the same geological strata. The observations at Pittsburg were preliminary, and it is hoped that a very complete and satisfactory series of temperatures will be obtained, owing to the generous public spirit of the Forest Oil Co., who have practically placed the well at the service of science. It is planned to drill it much deeper.

W. Hallock,
Secretary of Section.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis, of March 1, 1897, Mr. William H. Rush presented a demonstration of the formation of carbon dioxide and alcohol as a result of the intramolecular respiration of seeds and other vegetable structures in an atmosphere containing no free oxygen. The theory of the dissolution and reconstruction of the living nitrogenous molecules was explained in connection with the experiments, and the different behavior of these molecules when supplied with or deprived of free oxygen was indicated.

Mr. H. von Schrenk briefly described certain œdematous enlargements which he had observed at the beginning of the present winter, near the root tips of specimens of *Salix nigra*, growing along the edge of a body of water. The speaker compared these with the œdemata of tomato leaves and apple twigs which were studied some years since at Cornell University.

Professor J. H. Kinealy exhibited a glass model illustrating the mode of action of the Pohle air-lift pump, the efficiency of which he had discussed at the preceding meeting.

One name was proposed for active membership.

William Trelease,
Recording Secretary.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, MARCH 19, 1897.

CONTENTS:

The Fur-seal Investigation of 1896.....453
Proposed Exploration on the Coasts of the North Pacific Ocean.....455
The New York State Science Teachers' Association (I.), including the Address of the President, S. H. Gage and Addresses by Albert L. Arey and E. L. Nichols: FRANKLIN W. BARROWS.....457
Current Notes on Meteorology:—
Blue Hill Cloud Observations; Some Climatic Features of the Arid Regions; Climatic Zones on the Island of Sakhalin: R. DEC. WARD.....468
Current Notes on Anthropology:—
Stature and Weight; The National Museum of Costa Rica: D. G. BRINTON.....469
Notes on Inorganic Chemistry: J. L. H.....470
Scientific Notes and News:—
Research and the University; Science in the Newspapers; General.....470
University and Educational News.....475
Discussion and Correspondence:—
The Florida Sea-monster: A. E. VERRILL. *The Florida Monster:* F. A. LUCAS. *Gibbers:* J. B. WOODWORTH. *International Congress of Mathematicians at Zurich in 1897:* GEORGE BRUCE HALSTED. *A New Geographical Magazine:* ISRAEL C. RUSSELL. *Compliment or Plagiarism:* BEMAN AND SMITH. *Mexican Hieroglyphs:* J. D. MCGUIRE, ZELIA NUTTALL. *The Play of Animals; The Fur Seal:* F. A. LUCAS.....476
Scientific Literature:—
Biedermann's Electro-Physiology: HENRY SEWALL. *Tuber on the Coming Ice Age:* G. FREDERICK WRIGHT. *Mercer's Researches upon the Antiquity of Man:* D. G. BRINTON.....481
Scientific Journals:—
The Physical Review: American Geologist.....484
Societies and Academies:—
Biological Society of Washington: F. A. LUCAS. *Anthropological Society of Washington:* J. H. MCCORMICK. *The New York Section of the American Chemical Society:* DURAND WOODMAN. *The Geological Club of the University of Minnesota:* CHAS. P. BERKEY. *The Texas Academy of Science:* FREDERIC W. SIMONDS...487
New Books.....488

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE FUR-SEAL INVESTIGATION OF 1896.

THE preliminary report of the commission appointed in June, 1896, to investigate the condition of the northern fur-seals has recently been issued, although it has been in print for some time. It gives a resumé of the summer's work and of the conclusions reached, and will be followed later on by a full report giving in detail the observations and facts on which this summary is based. The work was prosecuted under exceptionally favorable conditions, not only from the facilities afforded the commission, but from the number of observers engaged, since what was not seen at one time or place might be seen at another, while the representatives of the various governments worked harmoniously together in the accumulation of data. Much, too, is also due to the thorough manner in which the work was planned and carried on by Dr. Jordan, the head of the American commission, while finally the reduced number of seals facilitated the work of observation.

We have for the first time a fairly accurate census of breeding seals, based not on estimates, but on an actual count of females and males present on the breeding grounds, checked by comparison with the number of young seals present. This last is an important factor, since a count of the pups shows that only about one-half the females are on the rookery grounds at any one time. While an *exact* census is, from the nature of things, impossible, it appears that there were in October, 1896, a little less than 360,000 seals left on the Pribilof Islands, 123,000 being breeding females, 5,009 males with harems, and 2,966 idle bulls, or those which were unable to secure any females through the scarcity of those due to pelagic sealing.

The breeding habits of the seals were carefully studied and the facts definitely settled that the young 'cows' make their appearance on the rookeries for the first time at the age of two years. This occurs late in July, after the vast majority of young have been born and the breeding grounds or rockeries have lost the compact appearance they present earlier in the season, and the arrangement of the females in regular fixed harems has been broken up; the young females are not in the harems with the older cows. Mr. Townsend's investigations of the condition of female seals taken at sea were continued and extended and fully corroborate his conclusions that, with rare exceptions, all over two years old taken during August and September are not only pregnant but nursing. The statements that the females taken at sea are largely barren or non-breeding are unsupported by any shadow of evidence, as are the assertions that the fur-seal breeds biennially, all observations proving that seals bear annually and throughout life.

Some additions have been made to our knowledge of the food of the fur-seal, although the data for this have mostly been obtained by Mr. Townsend and Mr. Alexander in previous years. In Bering Sea the Alaskan Pollack (*Pollachius chalcogrammus*) forms by far the most important item of the seal's diet, a squid (*Gonatus amœnus*) coming next. Salmon are eaten when found, and large numbers of a small, undescribed fish, allied to the Surf Smelt (*Hypomesus olidus*). Cod are not touched, at least in only one case out of three hundred, nor any species of bottom-frequenting fish, the seals feeding on such as are found near the surface, while the feeding grounds are in deep water. In regard to the young it is clearly shown that up to the time of leaving the islands they subsist entirely on their mother's milk, deriving no nourishment from fish or crustaceans, much less if the hibernicism be allowed, from kelp or sea weed. Thus every seal pup whose mother is killed at sea inevitably perishes from starvation, even the largest gray pups being unable to care for themselves late in October.

An important feature of the work of the commission was the ascertaining of the fact that a large number of seals die when very young and the reason for this loss of life. It has been generally considered that *all* seal pups which have been found dead of late years have starved to death on account of the loss of their mothers from pelagic sealing. On the other hand, the English commissioners in 1892 took the ground that there was a considerable loss from other causes, particularly drowning and epidemics. As a result of the investigations of 1896, it is now known that many young seals die before they are a month old and prior to the date on which pelagic sealing begins, through being trampled on by the old seals and mainly by the bulls. This loss does not take place all over the breeding grounds, but is almost wholly confined to those sections which are level or free from boulders. In such places there is no

protection for the young and no obstruction to the movements of the adults, and in consequence there is great loss of life through the quarrels of the bulls and the commotion thus caused among the others, during which the small pups are trampled under foot and many killed. In rocky places there is little loss, and about a fortnight or so after birth the pups draw out of the breeding grounds and are comparatively safe. A few young seals are drowned and a few die from disease or are killed by accidents, and a few starve from the death of their mothers and other unknown causes, but the number is not great and there is no evidence of any epidemic. All the dead seals were counted between August 6th and August 14th, or as soon as conditions would allow, and there were found 28 adult males, 131 females and 11,045 young, over 10,000 of these latter having been killed by trampling. The old bulls are killed in combat and the females by being pulled about in the struggles for their possession which take place among the bulls. The vast majority of young are killed so early in the season that by the time it is possible to enter the breeding ground they are in an advanced stage of decomposition.

In October the dead seals were again counted, and 14,343 were found starved to death, and 1,546 more in a perishing condition, all this being directly due to the killing of females at sea.

In regard to pelagic sealing, and the effects of the award of the Paris Tribunal, the conclusions are emphatically expressed, and, while there has never been any doubt on these points in the minds of those who have given them the least unprejudiced attention, it is to be hoped that some impression may be made even on prejudiced minds. The closed zone of 60 miles about the islands affords little real protection, save against raids, since the majority of seals feed at a distance of 75 to 150 miles from the Pribilofs, and all that the sealers need do is to lie just outside the 60-mile limit and there await the coming of the seals. The selection of August as an open month is about the worst that could be made, as during that month the weather is the finest of the year and the most seals are going to and coming from the feeding grounds. The majority of seals taken at sea are females, and nursing females at that, all reports that the numbers of sexes are even approximately equal being intentionally or unintentionally false.

The nursing females are obliged to go to sea in search of food at times when the males are safe on shore or in the vicinity of the islands, and, as they are not allowed to leave their harems until impregnated, the killing of each nursing seal means the death of her pup, as well as the loss of that which would have been born during the succeeding season.

It is evident that pelagic sealing and the seal herd cannot exist together; the continuation of the one means the practical extermination of the other, and nothing short of the total cessation of pelagic sealing will enable the seals to recuperate. The closure of Bering Sea might possibly preserve the seals in their present reduced condition, but this is by no means certain, as they are exposed to capture all the way from San Francisco to the Aleutian Islands during six months of the year, and, so long as pelagic sealing is permitted at all, the fur-seal question cannot be considered as settled.

PROPOSED EXPLORATIONS ON THE COASTS OF THE NORTH PACIFIC OCEAN.

THE American Museum of Natural History is about to undertake a systematic exploration of the peoples inhabiting the coasts of the North Pacific Ocean between the Amoor River in Asia and Columbia River in America. The funds for this important undertaking have been very generously

provided by Mr. Morris K. Jesup, President of the Museum, who has done so much already for the advancement of science and for furthering the work of the American Museum of Natural History. In 1895 he fitted out the Peary Relief Expedition, which extended the needed assistance to Lieut. Peary and thus resulted in important advances in our knowledge of northern Greenland and in valuable additions to the Museum. He also contributed the means for the Jesup Collection of North American woods, which is the best existing collection of North American foresty.

The explorations on the coasts of the North Pacific Ocean are intended to cover a period of six years, during which time the investigations are to be carried on in both Asia and America.

There are few problems that are of greater importance to our knowledge of the early history of the American race than its relations to the races of the Old World. The discussion of this problem has been going on for a long period, but its study has never been taken up in a systematic manner. While some investigators maintain that American culture has grown up spontaneously, others claim to recognize traces of Asiatic culture in America. Two ways of connection between the New World and the Old have been suggested: the one leading over the islands of the Pacific Ocean to South America; the other leading along the coasts of the North Pacific coast to our continent. The problem that it is proposed to take up relates to the northern area. In recent time F. Ratzel, Otis T. Mason and Franz Boas have published studies which favor the theory that an early exchange of cultural achievements took place between northeastern Asia and western America, but it cannot be said that this opinion has been established beyond doubt. It is combated notably by D. G. Brinton.

Still more doubtful is the racial relationship between the peoples of Asia and America, and when Boas expressed the opinion that the peoples of British Columbia are more closely related to the Asiatic race than any other North American Indians he did not bring forward any material from the Asiatic side to sustain his assertion. The final solution of these questions requires a systematic study of the whole area. Anthropologists will appreciate the generosity of Mr. Jesup, who makes it possible to investigate this important problem energetically before the destructive influences of civilization have destroyed the primitive cultures entirely.

Our knowledge of the ethnology of the Pacific coast of Siberia is largely based upon the reports of early travelers. Steller's description of Kamchatka supplies a gap that cannot be filled to-day. The circumnavigations of the globe of the last century and of the beginning of this century have furnished us with fragmentary material from these regions, but the only contribution that can claim any great scientific value is that of Schrenck on the peoples of the Amoor. Notwithstanding this work, and the publications of Middendorf, Castrén, Schiefner and Radloff, the types of man, the languages, customs and mythologies of the whole region are practically unknown.

On the American side our information is somewhat fuller. From southern Alaska and the Aleutian Islands we have the linguistic works of Vemiaminoff, the great Russian missionary; of Dall, Pinart, Krause and Emmons. From Arctic Alaska we have mainly the work of Murdoch on the Eskimo of Point Barrow. Investigations in British Columbia have been carried on for a number of years under the auspices of the British Association for the Advancement of Science, mainly by Boas, but much remains to be done.

Work on the Pacific coast of America will be commenced this spring in fields that

have heretofore remained unexplored, and will be continued as long as important gaps in our knowledge of the ethnology of the coast remain to be filled.

The regions in which investigations are to be carried on offer many peculiar difficulties, as well on account of the severity of the climate in the northern portions of the district as on account of the multitude of tribes that inhabit these regions. While almost the whole of Siberia is inhabited by tribes akin in language and similar in type, the eastern coast is occupied by a variety of races. The same is true in America, where in the interior we find a vast sweep of country inhabited by one people, while the diversity of languages and races on the coast is almost incredible. A thorough study of all the innumerable dialects, of the customs of all the tribes and of the physical characteristics, will be required to bring order into this chaos.

The difficulties of this problem will be better appreciated when it is stated that between Columbia River and Behring Strait ten languages are found that are fundamentally distinct, and that these languages have 37 dialects which are mutually unintelligible. On the Asiatic side there are seven distinct languages spoken in at least ten dialects which are mutually unintelligible, but there may be more since our knowledge of the whole area is very meagre.

The problem of the relationship of the racial types is a very attractive one. The relations of the races of southern Alaska and British Columbia to the other North American Indians, although not quite clear, are certainly very intimate, since a gradual transition of the northwest-coast types to those of eastern North America can be established. On the other hand, their features show a decided resemblance with the Asiatic types, but the races which we find in northern Alaska are much more remote from Asiatic types than those further south. It is, therefore, likely that extensive migrations have taken place in this whole area.

We know that great changes in the seats of population have occurred in the central parts of northern Siberia. The weaker peoples of southern regions were pushed northward and finally came to occupy the inhospitable shore of the Arctic Ocean. It will require long and patient study of the inhabitants and of the prehistoric remains of the whole region to unravel its ancient history.

Even after the time of the early migrations of races in this region there has always been opportunity for intercourse and for exchange of inventions and of other ideas. The forms of certain utensils are much alike on both coasts, thus favoring the theory that they has spread over the whole area from one center, but archæological investigation must show how long these forms have been in use and if they were preceded by other forms of culture. The mythologies must be scanned with great care. There is no doubt that among the people of Siberia a constant interchange of tales and myths has taken place. There are indications that the current flowed across to our continent, and it will be the task of the proposed investigation to discover to what extent American and Asiatic ideas influenced each other.

The whole field of research is a vast one, and it is to be expected that the enterprise inaugurated by Mr. Jesup will lead to results which will clear up many of the obscure points regarding the early history of the American race.

THE NEW YORK STATE SCIENCE TEACHERS' ASSOCIATION.

THIS Association, which was organized last July in connection with the Buffalo meeting of the National Educational Association, held its first annual meeting in Syracuse, December 29th–31st, following the

holiday conference of the Academic Principals of New York State.

Tuesday evening, December 29th, President J. G. Schurman, of Cornell University, addressed a joint meeting of the three educational bodies convened in Syracuse; his subject was 'College entrance requirements and the High School curriculum.' President Schurman expressed a strong disposition to encourage more thorough science work in our high schools by accepting sciences in preparation for college, and outlined several preparatory courses in which science should form an important part.

The meeting of the Association opened on Wednesday afternoon with the following paper by the President, Professor Simon H. Gage, of Cornell University:

The Purpose of the New York State Science Teachers' Association and the Work it Hopes to Accomplish.

It is a source of congratulation that the Science Teachers of the Empire State are no longer to remain scattered and unorganized, but by association are to gain the encouragement and enthusiasm which united effort brings. That enthusiasm and efficiency are promoted by such organizations of science teachers is abundantly attested by the results gained through the efforts of the American Society of Naturalists, and the teachers of Illinois, Colorado, California, and of other sections.

An association like this makes it easier for the college and for the secondary school teacher to come together and talk over matters of mutual interest and concern. In these friendly consultations and discussions there will be a chance of finding out something of what is most desirable and what is practicable and possible in the schools each represents. And in these discussions it will not be possible to forget the children in the elementary schools, the great majority of whom come neither under the training of the high school nor of the college, but must be content to get the best they can from the elementary schools to equip them for the struggle of life which stands so near them. What help have these a right to ask from the high school and the college? And then the great world of thought and action whose mighty stream, sooner or later, draws all into it, what does it demand? It is, after all, the final court which tries all alike, and puts each to the test whether he be a college graduate, high school graduate, pupil of an elementary school or one who has only his hereditary endowment of mother wit.

The signs of the times all indicate that the high school teacher is to be at least a college graduate, and the elementary school teacher a high-school graduate. If this is true, while the college has but few under its immediate instruction it determines the character of the high school, and in turn the high school determines the character of the elementary school. The college is then the intellectual guide of the land. Is it and has it always been a wise and sympathetic guide?

If we compare our times with those of 500 or even 100 years ago there will be found an immense difference, and science is largely responsible for this difference. Whether we approve or not, things are not as they once were; whether we designate the change as one of progress or decline, there has been change, the world is not what it once was. The modern citizen must adapt himself to these changes or be ground to powder in the struggle for existence or for preëminence. The professional man, if he is a physician, is a criminal if he does not know and apply the science bearing upon his profession; and the lawyer who has only the knowledge that the Middle Ages might have given him is soon eliminated from the race. It is with hesitation that I speak of the clergyman, but if he misrepresents na-

ture which he might know, and to which he so often reverts for illustration, how can he expect unhesitating acceptance of his words concerning the profound mysteries that all, even the most favored, must 'now see as through a glass darkly'? The artisan, farmer and business man cannot live as did their forefathers; and so from the professions, from all the people, there comes an appeal so earnest, so pressing, that we cannot choose but hear. If they suffer for lack of knowledge we must do our best to supply the knowledge. In place of lofty isolation, or worse, of indifference, we should give them the science we possess, show them the way it is gained, and how much there is yet to be gained, and thus make every boy and girl, and through them every man and woman, in our great State an observer or original investigator in science. This can come about only when real science is taught and studied, only when the fog of opinion and baseless authority are brushed aside and the pupils in the schools are brought in direct contact with nature, and there learn to appreciate and apply the scientific method so admirably stated by St. Paul: "Prove all things, hold fast that which is good."

Our Association ought not and cannot stop with the work of the high school. From the elementary schools most pupils must enter the labors of life; they make the bulk of the State, and a noble patriotism should lead us to do all we can for them. On the principle of self-preservation also such help is wise, for the work of high school and college alike have their foundations laid in the elementary school. As the college reaches down to help and encourage the high school, so should the high school reach down and help and encourage the elementary school, and thus will it come about that every child in the State will be brought into direct contact with nature, where he can experience for himself her inspiring and uplifting sympathy.

If this program is to be carried out the college must train its students and prepare them to take the true science, science at first hand into the high school, and banish therefrom anything savoring of sham. Then the college must honor its graduates by accepting for entrance the work in science of the high school on equal terms with other subjects taught by its graduates. To bring this about, I take it, is one of the duties of this Association. Thanks to the work of the American Society of Naturalists, and to the many able men and women who have worked for the same end, science work done in the high school is at the present moment recognized by a considerable number of colleges. See SCIENCE, December 25, 1896.

It is discouraging, almost prohibitive, for the college to say to the secondary school, when you reach the proper degree of excellence in your science work, the college will consider your appeal for recognition. Why cannot the college state fairly and explicitly exactly what the standard of excellence should be? and with equal fairness and justice say, when your students reach this standard we will accept them for entrance on the same terms as for other good preparatory work. No true friend of science would ask the college to admit students with a training in science inferior to that required in the older disciplines. Let the college make its standard as high as it will, but let it recognize the work that comes up to its standard, and thereby honor its own graduates who have so worthily brought the work of their pupils up to the high standard. Such recognition would put science on a fair footing with the other disciplines. It would encourage and inspire the teacher in the secondary schools and help to give his work a dignity and importance in the eyes of his pupils and colleagues. which it can never have if it is not honored by the college. Men still respect and honor

what the college approves, and it is a part of our work to see to it that the college puts the seal of its approval on sound learning in science as well as on that of the other disciplines which it accepts for entrance to its halls.

It seems to me the way before us is clear. Changed conditions have brought new needs, needs that knowledge of science can alone supply. We should do our best to help our day and generation, and in giving it the help of science and the sympathy of nature I feel confident that we are doing right in every way. Science, taught as every true teacher will teach it, will help the students to gain an insight into nature, will bring them face to face with reality, with law and order, and certainly will form at least one element in a noble education. It will emphasize the old lesson that power over nature comes only by obedience to her, and by this obedience, which can come only through understanding, discipline is gained. By action in accordance with law which is understood, and by reflection comes culture. With this discipline and culture come large sympathies and a wide outlook upon the universe. There comes also the consciousness that, while the current of life and law is irresistible, man is a part of the mighty current and his will has its due share in directing it.

Professor Albert L. Arey, of Rochester Free Academy, introduced the topic of the afternoon in the following address:

The Educational Value of the Physical Sciences.

It needs no skilled observer of the recent progress in educational affairs to discover that we are rapidly approaching that utopian condition in which the system of education shall be a system in fact as well as in name, and in which the work of the secondary school shall end where the college work begins, or, if you prefer the idea in this form, in which every subject that is entitled to a place in the secondary school shall be required for admission to some course in college.

As teachers of the sciences it is our duty to accelerate the progress towards this end by all means in our power and to retard it neither by strife among ourselves because of conflicting opinions nor by inaction because of no opinion; but rather, by studying the problems confronting us in the same judicial spirit with which we study those of nature, to seek out the truth, and by discussion of our observations and conclusions to speedily settle mooted questions among ourselves. Among these unsettled questions which we may profitably discuss is this: Which science shall be required for admission to college, if but one is required?

My own answer to this question would be, Physics; first, because of its fundamental character. Bacon long ago said that physics was the mother of sciences. The laws and facts of physics are necessary to the understanding of all other sciences; chemistry is becoming more and more a study of the transformations of energy, and the biologic group is tending in the same direction, while in geology a knowledge of physics is more necessary than in either of those mentioned. Without its aid the action of the grand forces which have moulded the earth cannot be comprehended. And, second, its cultural and informative values are at least equal to those of the other sciences. The logical order in mind-building, as in house-building, is to begin at the bottom, and therefore physics should be required for admission to college if but one science is required. I am aware that several societies of schoolmasters have discussed this question, and that in some cases they have reached the conclusion that some other science should be first. And I hardly expect my friends, the biologists, to agree with me, but friendly discussion leads to progress, and I hope that we

all desire to know the truth more than we desire the triumph of our own convictions.

Other unsettled questions relate to the methods of instruction to be employed in the several branches of science, and these are important.

The methods of teaching the languages and mathematics have been refined by accumulated experience and they are substantially uniform throughout the world, while the teaching of science is of comparatively recent introduction and the variety of methods employed is great; under these conditions uniformity of results in older subjects and great variety in science is what should be expected, and, other things being equal, it is what is obtained.

It behooves us then to accumulate our experience that we may determine upon and adopt *our* best method. The 'Committee of Ten' performed a valuable service in giving us the outlines of a method of teaching physics and chemistry, and most teachers endorse their recommendation, "that these subjects be taught by a combination of laboratory work, text-book and thorough didactic instruction carried on conjointly, and that at least one-half of the time devoted to these subjects be given to laboratory work;" but these directions are not explicit enough to prevent the teacher from doing poor work, even though he follows the suggestions to the letter, and we may profitably consider the objects and the possibilities of the subjects from an educational standpoint.

Properly taught, both physics and chemistry yield splendid mental growth; they lead to valuable lessons of law and order; their facts are important and useful, and they furnish a kind of manual training of a high order of merit. Without desiring to belittle the other possibilities, I shall confine myself to the discussion of the mental growth which may be derived from these subjects, for this is the true education, the culture which remains to the student when the facts of the subject have long been forgotten. Although the cultural value of the sciences was not at once admitted when first claimed, and although we as teachers sometimes lose sight of this point, it is an easy matter to show, as Spencer has done in the first chapter of his 'Education,' that the mental growth which results from the proper pursuit of the sciences is beyond compare the best.

Furthermore, the amount of culture which may be derived from scientific subjects is not limited, as is that which may be obtained from other subjects. The longer one studies a language, the more expert he becomes in the application of the accidental rules of its grammar, and correspondingly less exertion is required for the solution of the somewhat similar problems in construction; but in science, while he becomes more expert in the application of the necessary truths which he assimilates as time goes on, he attacks more and more profound problems, and the mental activity increases; and he can never reach the end, for there are problems in nature which can only be comprehended by the perfect mind of the Creator. As Huxley says, we reach the summit of the mountain we have set ourselves to climb, only to find that it is but a spur of the greater range beyond. And now let us consider *what* faculties of the mind may be developed by the study of physics and chemistry, and how they may be best developed. Remembering that the mind is stimulated to activity in certain directions by frequent exercise in these directions, just as skill in following a trail was developed in the Indian, our question becomes: What opportunities do these subjects afford for the exercise of the mental powers?

Concerning the evolution of the ability to remember, little need be said. This power may be cultivated by the text-book and reci-

tation method, without experiments, without laboratory work, without apparatus, often without even understanding, but what a worthless reward is received for the effort. Our pupils come to the secondary schools with memories so abnormally developed that they have atrophied the interest in nature which each of them inherited, and have made serious inroads upon their reasoning powers.

Perception is rapidly and easily developed by laboratory work. It is the universal testimony of those who have conducted laboratory classes that the students learn to observe accurately and well, but this faculty is not necessarily exercised by either the recitation or the lecture method.

Faraday said: "Society, speaking generally, is not only ignorant as respects education of the judgment, but is ignorant of its ignorance;" and the cause to which he ascribes this state is want of scientific culture.

Herbert Spencer, in his 'Education,' says: "Every step in a scientific investigation is submitted to his (the student's) judgment. And the trust in his own powers thus produced is further increased by the constancy with which nature justifies his conclusions when they are correctly drawn." And he adds: "From all this flows that independence which is a most valuable element in character;" and Professor Bessey, in an address on 'Science and Culture,' delivered in Buffalo last July, says: "The proper pursuit of science should develop a judicial state of mind toward all problems."

Here is abundant evidence that the judgment may be cultivated by proper work in science, and that the student may acquire confidence in his own judgment; but this also can only be accomplished in the laboratory.

The cultivation of the imagination is another of the possibilities. Professor Carhart, in his address to the Science Department of the National Educational Association, says: "It is no new thought that scientific study makes a draft upon the imagination." And this may be best accomplished in the laboratory, although in the hands of a skillful teacher lesser but valuable results may be obtained in the class room.

The class-room work may be, and generally is, so conducted as to afford training in deductive reasoning, such as is derived from courses in mathematics. The solution of problems in physics affords particularly valuable exercise of the mind in this direction if the problems are judiciously selected, but there is a great difference in the benefits derived from the different problems; for instance, to solve such problems as the following requires very little mental friction: "What is the pressure on the upper surface of a Saratoga trunk, 2 by 3 feet?" while the solution of the following problem will compel thought which yields valuable results: "An empty toy balloon weighs 5 g. when filled with 10 l. of hydrogen; what load can it lift?"

The repeated solution of problems based upon the same formula is not to be commended, since the operation soon becomes mechanical, and therefore of slight cultural value, but the skillful teacher can easily introduce some new point into each problem, if he keeps in mind the object of his work. Furthermore, the discussions of the class room may be so shaped as to afford practice in deductive reasoning; the application of theory to the objects of everyday life, the illustrations of the laws, principles and definitions, and questions like 'Account for the slowness with which ice increases in thickness over a pond,' are easily presented to the pupil so as to develop power in this line. The prevailing tendency is, I think, to spend too much time on this class of work, for this is the particular province of mathematics, and deductive reasoning is of less value than

inductive reasoning, because it leads to no higher intellectual level than that of the major premise. Every conclusion and every thought is subordinate to that with which we begin the process, while inductive reasoning proceeds to broader and grander facts, which tax the human mind more and more in the effort to comprehend them.

Now, let us consider in what manner we may develop power to reason inductively. In the lecture room the teacher may lead his class step by step through an inductive process, and he may receive evidence that they have followed him in answer to such questions as, "Why do you believe that magnetism is a molecular phenomenon?" or "Why do you believe that a body in motion will continue in motion indefinitely, unless acted upon by some external force?" But discipline in inductive reasoning is best obtained in the laboratory. It is not derived from such experiments as determining the coefficient of expansion of iron or measuring the resistance of a coil of wire. This class of work is similar to the work that a mechanic does in sharpening and repairing his tools. It may furnish useful manual training, but no such discipline as does the measuring the resistance of many coils of wire so selected as to furnish a line of argument confirming the laws of resistance. Neither do such exercises as the last possess any such value as do original researches; here the experimental method reaches its maximum value.

We thus see that laboratory work is necessary to the best development of the pupil's mind, and that the object of the laboratory course is not to discover laws and facts; not to prove that the book tells the truth; not the manual training involved; but its great advantage over other means of developing the mind.

We see also that class-room work may be made valuable and that it is necessary, because of the culture derived by the students, and because of the opportunity which the teacher is afforded of guiding the students' mental processes, and this combination of laboratory and class-room work is the plan recommended by the 'Committee of Ten.' Let us call it the American method for the present.

If I catch the spirit of the method of instruction in science employed in the schools of Germany, it is expressed in one word—'Questions'—questions which lead the students step by step through their own thoughts to the facts and laws of the sciences. I am unwilling to admit that in the products of corresponding schools the German is superior to the American; but I believe that we may with profit combine the two phases, and that increased educational value will be found in experiments which are performed with a set of questions to be answered before the pupil. Not such questions as "What color is this gas?" but questions so shaped as to compel thinking and to guide the thoughts of the student. In many experimental sciences the directions for experiments are accompanied by questions, but most of them are intended to call attention to facts. What I insist upon is that the teacher have in mind the mental process to which the question will lead the student. In closing, let me say that I found the Regent's syllabus in physics altogether too long for this class of work, and I believe that many teachers who are ready to do this higher grade of work are now rushing through the long course, developing only the memory.

Last November, in his opening address as President of Section A of the British Association, Professor J. J. Thompson says: "I hope I may not be considered ungrateful if I express the opinion that, in the zeal and energy which is now spent in the teaching of physics in schools, there may lurk a temptation to make pupils cover too much ground. It is, indeed, not uncommon to

find boys of seventeen or eighteen who have compassed almost the whole range of physical subjects. Physics can be so taught as to be a subject of the greatest possible educational value, but when it is so, it is not so much because the student acquires a knowledge of a number of interesting facts as by the mental training which the study affords in, as Maxwell says, 'bringing our theoretical knowledge to bear on the objects, and the objects on our theoretical knowledge.'

"I think this training can be got better by going very slowly through such a subject as mechanics, making students try innumerable experiments of the simplest kind, rather than by attempting to cover the whole range of mechanics, light, heat, sound, electricity and magnetism." And he concludes by saying: "I confess I regret the presence, in examinations intended for school boys, of many of these subjects."

Discussion by Professor E. L. Nichols on the Teaching of Physics and Chemistry in the Secondary Schools.

One of the chief difficulties with which we have to cope in considering the subject of science teaching in the schools lies in the fact that the schools have to handle two distinct classes of pupils: The large class which is not going to college and for which the education in science received in the schools is all that they are to receive, and a much smaller class with which the science taught in the schools is preparatory to the further study of science in the college and the university.

It is most unfortunate that our high schools and academies are obliged to treat these two classes of pupils together instead of offering them entirely distinct courses of study. If physics and chemistry, for example, are to be accepted by the universities as entrance subjects alternative with mathematics they must be so taught as to have a disciplinary value in some degree comparable to mathematics. Now, the disciplinary value of mathematics is universally conceded to be exceedingly high.

It is unquestionably possible to teach science in such a manner as to afford excellent mental discipline, but in order to do so the teacher must be thoroughly up in his subject and he must have this continually in view as the prime object of the instruction which he is giving. For the larger class of pupils, on the other hand, to whom the courses in physics and chemistry offered by the schools are all that they are to receive, the object for which the teacher must strive is in great part to convey useful information. In a word, the two objects sought cannot well be united in a single course.

In spite of the fact that nearly all the principals and superintendents of schools with whom I have spoken upon this subject have held it to be impracticable to separate the pupils who are preparing for college from those whom the high school or academy is to afford the completion of their education, I feel compelled to lay down as a first principle that a thoroughly satisfactory substitute for the advanced mathematics now required for entrance to college can only be obtained by teaching science to those preparing for college in an entirely different manner, and indeed in different classes from those who are not preparing for the entrance examinations. Where no such division can be made it is at least possible to treat the science *primarily* with a view to its *disciplinary* or *truly educational* value.

It is scarcely necessary to say that all sciences are to be treated as laboratory subjects. No school course in physics or chemistry which consists in the reading of a text-book, together with recitations upon the same, can possibly afford a suitable preparatory course for college. Neither will such a course prove of any appreci-

able advantage to the class of non-college going pupils. It were in my opinion far better to exclude science teaching from the schools altogether than to teach it in this way. The plan very generally followed in our schools of accompanying recitations upon such a text as indicated above by demonstrations with apparatus performed by the teacher does not call for so sweeping a condemnation; yet let me say plainly that no such course can be regarded as an adequate entrance requirement.

In both physics and chemistry, laboratory instruction is to be regarded as the essential thing; this is to be accompanied, in so far as time may permit, by the reading of a text-book and by demonstrations on the part of the teacher. Since the time allotted to these subjects is rarely large enough to make it practicable to use two books—a text-book and a laboratory manual—the text-book selected should be one written with a view to the teaching of the subject by laboratory methods. It should combine the features of the laboratory manual and the ordinary text-book of physics in brief and clear form. With a good book of this kind the teacher who understands his subject will select certain experiments to be performed by each member of the class individually; others he will reserve for demonstrations to be performed by himself in the presence of the class. The principles illustrated by these experiments, which should be so selected as to demonstrate the laws of the science, should form the subject matter of recitations. The lower the grade of the pupils the more prominent should the laboratory features of the course be made.

I am aware that in our larger schools there are considerable difficulties in carrying out a program such as I have outlined. The chief difficulty is not one, however, which is confined to the teaching of science; the fact is, that in all subjects the number of teachers is entirely too small in proportion to the size of the classes. The difference between the teaching of science and the teaching of other subjects is that in science teaching the attempt to cut down the teaching force, as is done in other subjects, leads inevitably to a complete failure. Such failure brings about too frequently the abandoning of proper science methods even where the teachers themselves are sufficiently well prepared in their subject to know what these methods are. If our school boards and superintendents and principles and teachers were equally honest in the teaching of other subjects they would feel compelled to abandon the teaching of these likewise. The increase in the teaching force demanded for the purpose of permitting the schools to offer satisfactory entrance requirement courses, therefore, is not an exorbitant demand; it is simply a demand which should be met in every department of school instruction. If the question of science teaching in the schools serves to bring this matter more forcibly than it has ever been brought to the attention of those whose duty it is to determine the teaching force in our schools a good work will have been done.

While first-rate work in laboratory teaching of science can not be done where the number of students to be handled by each teacher is very large, something may be done. It is, for example, better to have laboratory experiments carried on by the instructor in the presence of the class than not at all It is much better to have laboratory experiments carried on by groups of students than by the instructor himself. The efficiency of the teaching increases as the size of these groups is diminished, and it reaches its maximum only when the groups are reduced to one or two, or at most three, individuals.

Laboratory practice for the schools is intended to serve a double purpose. In the

first place, to teach the pupil to observe; in the second place, to give him practice in the simpler methods of measurement. It may be laid down as a general rule that quantitative methods should be employed whereever practicable, and that experiments in which a precise and definite result is reached are always to be selected. The metric system should be introduced at the very beginning and should be used *to the exclusion of all others* throughout the course. The introduction of the metric system of weights and measures into practical life in this country, for which strenuous efforts are now being made in many quarters, can be brought about more rapidly by its use in the schools than in any other way. The only thing which interferes with its immediate adoption by the people lies in their unfamiliarity with it. It may be confidently expected that within a few years this system will be used by our postoffice departments, in pharmacy and in every transaction between the government and the people. The schools, however, by the exclusion of the teaching of other systems in arithmetic and in science, can further the reform more effectively than all other agencies combined.

Finally, let me say a word or two with reference to the laboratory equipment. This in chemistry is not a serious matter. In physics, on the other hand, we find a great variety of opinions. There are those who hold that the best instruction is that which is carried on without the use of instruments; that school children should be taught to construct with spools and bits of string the philosophical apparatus which they are to use. We find, as the other extreme, equipments for demonstration, the price of which would involve the expenditure of tens of thousands of dollars. The proper course lies between these extremes. There are certain standard instruments which should be in the possession of every school laboratory for use in demonstration and in laboratory instruction. These are not excessively expensive nor is the number of such instruments very large. A balance with weights, an air pump of the very simplest form but properly constructed with accessories, a lantern for projection, a clock with pendulum, a metronome, thermometers, an abundant stock of glass tubing and of flasks and beakers, a galvanometer (which may be home-made), a simple resistance box, some lenses and prisms, a set of tuning forks, an organ pipe and a sonometer—these together with scales divided to millimeters, a micrometer gauge and a supply of cross-section paper will enable the properly trained teacher to give a very thorough course in laboratory instruction. Where the number of pupils to be handled is large it will be necessary to duplicate many of these instruments. Before the schools can hope, however, to offer science courses which will be acceptable alternatives for the advanced mathematics of our entrance requirement it will be necessary to have a sufficient number of teachers who are thoroughly trained for scientific work and suitably equipped laboratories. The demand of science as regards the number of teachers is not really greater than that of other branches, but it is more urgent, and the failure which comes from inadequate numbers is more disastrous.

Professor John F. Woodhull, of the Teachers College, New York City, referring to the one-year course in Physics, prescribed by the Regents of this State, explained that it was a compromise between the old twenty-weeks course and a better course which would require two years. It is to be hoped that the course will be further lengthened and made to include more laboratory work.

Dr. T. B. Stowell, of the State Normal School at Potsdam, urged the importance of instruments of precision in the class-

room. The charge that the sciences are not comparable with linguistics in educative value, by virtue of their inaccuracies, is not without foundation. If a student in Latin should be taught that the third personal ending of the verb is *t*, or some letter in that vicinity, the college entrance examination would disclose marvelous results. This is only a fair sample of the lax approximations accepted by the teachers of physics in much of their experimental work. No piece of mechanism is too exact to demonstrate physical law, especially if we are to demand that the colleges accept work in the sciences as equivalent to the languages.

An interesting discussion followed concerning the usefulness of home-made apparatus, both sides of the question being advocated. Dr. C. H. Sharp, of Cornell University, thought a well-equipped workshop should be one of the first essentials of every physical laboratory, and a means of providing many well-constructed pieces of apparatus. It was agreed, however, that the quality of the teacher is of higher moment than the apparatus, the good teacher being always superior to his instrument.

Dr. William Hallock, of Columbia University, stated that the 'new curriculum,' which goes into effect with the beginning of the year 1897–'98, permits the student to offer, instead of Greek, an equivalent in the physical sciences for entrance to Columbia. Hence this desirable step in the advancement of sound education is no longer untaken or uncontemplated in this State.

Speaking as a teacher in college he advocated the early study of physics. Mechanics is particularly well adapted to the training of the young mind to see, to think, and to express itself freely. If the preparatory school can teach the scholar to see, to think and to express his ideas; certainly the instructors in college will be very well satisfied with such a preparation, and will have the work of the further cultivation of science greatly facilitated. As a preparation for college it is not desirable that the student be initiated into the mysteries (?) of the ether and the electro-magnetic theory of light and other similar subjects; these, if ever taught, should be taught in college; recondite theoretical discussions are out of place in an elementary course; higher mathematics is also superfluous. It is possible to give a student a very comprehensive knowledge of even the more abstruse facts of physics without requiring a knowledge of mathematics beyond the rule of three. College professors have all been teaching elementary physics because their students came to them with no knowledge of science, but with a loose way of thinking and writing, which is very hard to correct at that stage of their mental development.

As a general educational course for those who do not go to college, the course in physical science is of undisputed value. Here also the mechanical-physical side is preferable to the chemical side, as being simpler, more easily grasped, and more readily and generally applicable to everyday experience. The necessary apparatus is not extensive, complicated or expensive. The course should include a well-selected series of experiments which should tend to a gradual development of the powers of observation, of thought and of expression, rather than to instructing the student in all the latest and most remarkable discoveries of science. If he has the desire and has once acquired the proper method of seeing and thinking, the student will have little trouble in picking up much more information than can possibly be given to him in any superficial course of cramming. Teach him to see, to think and to speak clearly, and all will be well.

Professor W. C. Peckham, of Adelphi College, urged that the attention of the young pupil should be directed to the phenonena of nature about him; to the

changes he may observe in the seasons, the days and the nights; the changes in the weather, the dews, the fogs and rain, hail, snow, the rainbow and the lightning flash. All these should be the occasion of instruction. He should be taught the laws of the action of any machines in the house, on the farm or in the mills of a neighborhood. In the later years of the grammar school and in the high school, place should be found for experimental physics in the illustration of laws. The demonstration of laws is beyond the power of the pupil of this age. This belongs to the well-equipped student of the University. Measurements adapted to the stage of advancement of the pupil may be made in all parts of such a course, though much that passes for physical-laboratory work is only physical arithmetic or geometry, and should be done in the time devoted to mathematics.

If such a course should be carried out, the student would early begin to observe, reflect upon and endeavor to explain what he sees before him in daily life, to be intelligent with reference to the course and constancy of nature. Everything will not then to him be shrouded in mystery and weighty with omen. Such knowledge acquired in the grammar and high-school years will constitute the surest and best foundation for the course in modern physics, the science of the transformation of energy as taught in the college.

The other speakers of the afternoon were Principal William M. Bennett, of Canandaigua; Principal Henry Pease, of Medina; Professor Irving P. Bishop, of Buffalo; Professor H. J. Schmitz, of Genesee; Professor Morris Loeb, of New York University; Professor G. C. Caldwell, of Cornell; Professor H. C. Coon, of Alfred, and Professor Henry L. Griffis, of New Paltz.

It was evident that on one point the Association is practically unanimous: that of all the sciences which the colleges might require for admission, physics is the one that the preparatory schools are best adapted to handle, and that the student is most in need of. The discussion showed clearly also that, in order to do the work in physics as it should be done, the secondary schools need to devote more time and thought to this work, and in some cases, perhaps, less time and thought to work in the other sciences. The laboratory method is indispensable. Several speakers were in favor of leaving all the work in chemistry to be done in college.

After the discussion, the following resolution, offered by Dr. Hallock, was unanimously adopted: "*Resolved*, That this Association urges Congress to take such action as will bring into use, by the government and by the people, the metric system of weights and measures at as early a date as is practicable."

Franklin W. Barrows,
Secretary.

Buffalo, N. Y.

(*To be continued.*)

CURRENT NOTES ON METEOROLOGY.

BLUE HILL CLOUD OBSERVATIONS.

Clayton's 'Discussion of the Cloud Observations' made at Blue Hill Observatory (Annals Astron. Obs'y Harv. Coll., Vol. XXX., Pt. IV.) is a product of which American science has abundant reason to be proud. It represents the results of years of the most careful work at Blue Hill Observatory on the heights, velocities, movements, formation and classification of clouds, and is, as it stands, the most complete publication on the subject of clouds yet issued in any country. That the observers at Blue Hill were doing some excellent cloud work has been known for some years, and short articles by the meteorologist of the station (Mr. H. H. Clayton), which have appeared from time to time in scientific journals in Europe and in this country, have given evidence that some interesting results were

being derived from this work. We venture to say, however, that very few persons indeed have had any idea of the extent or the value of the deductions which were being drawn from the vast body of material thus collected. No one who looks over this volume of 230 quarto pages can fail to be struck with the thoroughness, the exactness and the eminently scientific quality of the whole work. It is obviously impossible to attempt to discuss the publication in these notes. It is our desire simply to call attention to it and to recommend a careful study of it to all meteorologists. Blue Hill Observatory has certainly given us a piece of work which will be a lasting credit to American science.

SOME CLIMATIC FEATURES OF THE ARID REGIONS.

A PAPER on 'Some Climatic Features of the Arid Regions,' prepared by the Chief of the Weather Bureau for the National Irrigation Congress, whose fifth session was held at Phœnix, December 15–17, 1896, is published by the Weather Bureau. It deals with the general climatic characteristics of the southwestern portion of our country, and lays especial emphasis on the amount of wind movement, with a view to determining to what extent the wind may be used as a motive power in driving the mills to be used for irrigation purposes. Sensible temperatures, which have come into prominence recently, and are now regularly noted on our daily weather maps, come in for some share of attention, and two charts illustrate the average actual and sensible temperatures for summer, and the mean actual and sensible temperatures for July, 8 p. m. These charts show very clearly that it is in the regions of the West and Southwest, where the relative humidity is low, that there is the greatest difference between the sensible, or wet bulb, temperature and that of the dry bulb, while in the East, especially in the Northeast, where the relative humidity is much higher, the temperatures as shown by the wet and dry bulb readings are most nearly the same. It appears that there is an abundance of effective wind on the plains east of the Rocky Mountains in all months of the year, and no special adaptation of the ordinary windmill is necessary. The amount of effective wind decreases with approach to the Rocky Mountains.

CLIMATIC ZONES ON THE ISLAND OF SAKHALIN.

AN interesting fact regarding the relation of the floral zones and meteorological conditions on the island of Sakhalin is noted in *Ciel et Terre* (Jan. 1, 1897). This island, lying off-shore from the eastern coast of Siberia, is surrounded by cold currents and is further exposed to the cold northwest winds from the mainland. At sea-level snow falls in May and lasts till the end of that month, and the coast is very cold. The climate becomes milder with increasing distance from the sea and with increasing altitude, the cold air accumulating on the lowlands near sea-level. In consequence of this distribution of temperature the lowlands have an Arctic flora, while the highlands and the intermediate heights have a temperature and, in some cases, a sub-tropical flora. This is a curious reversal from the ordinary condition of things, which gives more and more boreal vegetation with increasing altitude.

R. DE C. WARD.
HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

STATURE AND WEIGHT.

THESE anthropological elements are discussed in a highly satisfactory manner by Dr. Buschan, of Stettin, editor of the *Centralblatt für Anthropologie*, in the 'Real-Encyclopädie der Gesammten Heilkunde,' now publishing in Berlin.

The shortest tribes are the African pygmies, who stand about 1.30 meters. In America no tribe is mentioned with an average under 1.60. The tallest are undoubtedly American, some (doubtful) Caribs of the Orinoco at 1.84, and the Tehuelche, of Patagonia, at 1.78.

The article on the weight gives abundant information about the relative weight of the brain and other organs.

Both articles contain a very complete bibliography of the recent scientific literature of the subjects.

THE NATIONAL MUSEUM OF COSTA RICA.

Largely owing to the energy of the Director Señor Anastasio Alfaro, the large archæological and ethnographic collection brought together by the government of Costa Rica has now been commodiously installed in a building erected for the purpose at San José de Costa Rica. A photograph of it is reproduced in *La Revista Nueva* for October last.

Few localities on our continent offer better specimens of aboriginal pottery and stone work that are discovered within the area of Costa Rica, as was abundantly illustrated at the Columbian Exposition at Madrid. A beautiful example of a decorated jar is given in the journal of the date mentioned, and also the outlines of a number of others.

In spite of the careful studies of Manuel de Peralta on the ancient tribes of Costa Rica, we still remain ignorant of the language and affinities of the tribe which seems to have left the most abundant remains—the Guetares.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

In the last *Berichte* F. Giesel describes an interesting instance of what are probably solid solutions. A little more than a year ago Goldstein showed that the halid salts of the alkali metals take on a more or less intensive color under the influence of kathode rays. Giesel obtains the same result by heating the salts in closed glass tubes at a very low red heat in sodium or potassium vapor. Bromid and iodid of potassium are colored a beautiful blue, chlorid of potassium or sylvine a dark heliotrope, chlorid of sodium or rock salt yellow or brown. The color is not superficial, as clear crystals of potassium bromid a centimeter cube are uniformly colored. The coloration seems to be due to the solution of the metallic sodium or potassium in the solid salt. It is thought probable by Giesel that the blue coloration of rock salt is due to dissolved sodium. Attempts to color in a similar way clear crystals of fluorspar were not successful.

In continuing his investigations into the occurrence of gold in nature, Professor Liversidge finds the metal in all natural saline deposits. Rock salt and other natural salts contain from one to two grains of gold per ton, while bittern waters and kelps furnished in some cases from fourteen to twenty grains.

Professor Liversidge has also examined the structure of gold nuggets from many different sources, by polishing and etching sections. He finds that all nuggets possess a well-marked crystalline structure and usually contain foreign substances. He suggests that the gold has been slowly deposited from aqueous solution and that the nuggets are more or less rolled masses of gold which have been set free from disintegrated veins.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

RESEARCH AND THE UNIVERSITY.

An editorial note in the February number of the *American Naturalist* has been quoted with approval in several journals. We also reproduce this note, partly in order to give it such

currency as we can, and partly in order to comment upon it:

"While the primary object of the University is instruction, there are several reasons why original research is of more than incidental importance to its prosperity. The mastery of his subject, which is characteristic of the man who advances the knowledge of it, is an essential of a good teacher. The belief in this truth is so general that the teacher who is known as a discoverer will more successfully attract students to his classes than he who is not so known. But, apart from this, the general reputation of a school before the public is more surely affected by the research work that issues from its faculty than the managing bodies of some of them seem willing to admit. As an advertisement, successful original work is incomparable. It serves this purpose in quarters where the detailed work of the university is of necessity unknown. We know how it is with our estimate of institutions of foreign lands; we know them by the work of their professors in original research. We believe that those universities which permit of the production of original work by those of its professors who have proven themselves competent for it are wise above those who do not do so. Those who load such men with teaching, so as to forbid such work, reduce their prosperity. We regret to learn that a tendency to the latter course is increasingly evident in some of our great schools. Who, in the chemical world, does not think the more highly of Harvard on account of the work of a Gibbs; how much better is Brown known through the work of a Packard, and so on? Chicago, Pennsylvania and Cornell profit greatly in various fields by the work turned out by certain members of their faculties. Who does not know Columbia, Princeton and Johns Hopkins as the seat of the labors of men whose names are familiar to every American? Yet, in a few of these institutions the prosperity brought by these very men is becoming the means of choking the vitality of these, their life centers, by the increase of drudgery which it brings. The managers will be wise to preserve for these men sufficient leisure to enable them to advance the frontiers of the known, and thus to obtain juster views of things as they are, and to bring us ever nearer to a comprehension of the great laws whose expressions it is their business to teach to the growing intelligences of the nation. By all means nourish the nuclei of the mental life, which will thus preserve the vitality of the cytoplasm of society and protect them from being smothered by it into stagnation and ultimate crystallization."

WE quite believe that research work advertises a university, and in a more effective manner than athletic contests. But we do not think that research is chiefly useful as an advertisement, nor that instruction is 'the primary object of the university.' Instruction, or better training, is the primary object of the college and professional school. Research is not only the primary object of the university; it is the university itself. Further, we think that this is the view of President Eliot, President Low, President Gilman, Provost Harrison and the other able leaders who are now laying the foundations of our universities. We do not see any tendency 'increasingly evident in some of of our great schools to load men with teaching so as to forbid' original work and 'choke their vitality.' Rather it is only within the past few years that the university, as we understand it, has been developed. A professorship, such as the editor of the *Naturalist* holds at the University of Pennsylvania, would not have been possible twenty years ago. The university professor must indeed learn that he may teach and teach that he may learn. It would, perhaps, be well if he more often gave a small part of his time to carrying the spirit of the university to the lower classes of the college. But research is the university; when both teachers and students are not advancing knowledge and applying it for the welfare of society, or learning how to do these things, they are only part of the university as its *impedimenta*.

SCIENCE IN THE NEWSPAPERS.

THE last number of *Nature* contains a leader traversing an editorial in a recent issue of the London *Times*. That journal is accused of an 'outburst' displaying 'misrepresentations' and 'absolute ignorance.' It is scarcely needful to say that in the question at issue—the desirability of establishing a National Physical Laboratory that will do for Great Britain what the *Reichsanstalt* does for Germany—we entirely agree with *Nature*. But the same number of the *Times* that the editor of *Nature* finds 'painful reading' set the writer of this note to wonder why the English daily press is so superior to our own. Of the four editorial articles in the *Times* of that issue, three were devoted to subjects that might be regarded as belonging to science. The point of view was, doubtless, that

of middle class Toryism, but the questions were discussed in a manner that appealed to an intelligent interest on the part of the readers. When the British Association meets, the address of the President is given in full, not only in the London dailies, but also in the provincial press, and pages are devoted to the sectional meetings. The New York papers contained one short note on the Buffalo meeting of the American Association for the Advancement of Science, and the local press confined its attention to our *enfant terrible*, Section I. The Boston *Transcript* probably gives more space to science than any other American daily and is one of the most respectable of our newspapers, yet it describes to its readers how the soul has been photographed by 'a member of the Paris Academy of Medicine' and how 'Sir' Francis Galton has established communication with the inhabitants of the planet Mars. There are often in the daily papers items of scientific news that should be of interest, but their 'probable error' is about ∞. While some of our newspapers are reverting to the pictograph stage of culture, will not one or two of them omit a few items of local and transient gossip and give a little space to subjects of permanent and universal importance?

GENERAL.

THE Berlin Academy of Sciences has made an appropriation of 2,400 Marks to Professor Harnack for the expenses of the preparation of a history of the Academy to be published on the occasion of the two hundredth anniversary of its foundation.

AT its last meeting, March 10th, the American Academy of Arts and Sciences elected as foreign honorary members Ludwig Boltzmann, of Vienna; Wilhelm Pfeffer, of Leipzig, and Wilhelm Dörpfeld, of Athens.

MR. GASTON DARBOUX, professor of geometry at the University of Paris, has been elected a corresponding member of the Berlin Academy of Sciences.

THE Zoological Society of New York has received official notification from the Board of Park Commissioners consenting to allot for a Zoological Park the portion of Bronx Park which the Society desired. The land designated is the southern portion of the park lying between Kingsbridge road and Pelham avenue and extending eastward from the southern boulevard so as to include the Bronx Lake and enclose two hundred and sixty-one acres of land. The largest Zoological Garden of Europe, that of Berlin, is only one-fourth this size.

THE Royal Botanic Society of London is considering the establishment of a Botanical Institute for the study and teaching of botany in its gardens. The subject was brought before the Society by Mr. William Martindale at a meeting of the fellows on February 27th, and the plan was favored by all who took part in the discussion.

SIR J. BLUNDELL MAPLE has given University College, London, £100,000 for the rebuilding of the hospital. Lady Wallace has bequeathed to the British nation the finest private collection of paintings and objects of art in the world, valued at between $5,000,000 and $10,000,000.

M. VIOLLE, of the École normale Supérieure, has been elected in the room of Fizeau, member of the section of physics of the Paris Academy.

JOSEPH JAMES SYLVESTER, the great mathematician, Savilian professor of geometry at Oxford, formerly professor at Johns Hopkins University, and in 1841 at the University of Virginia, died at London on March 15th, aged eighty-three years.

THE eminent mathematician, Dr. Karl Weierstrass, died at Berlin on Februry 19th, aged eighty-one years.

PROFESSOR HENRY DRUMMOND, of the Free Church College, Glasgow, died on March 11th, at the age of forty-six years. He had published interesting accounts of his travels in tropical Africa and elsewhere, but was best known for his 'Natural Law in the Spiritual World,' which has been published in many editions and in several languages. Professor Drummond gave the Lowell Lectures in Boston in 1893 which were published under the title 'The Ascent of Man.'

WE regret also to record the deaths of M. Georges Ville, the chemist, professor in the Paris Museum of Natural History; of Dr. Timothée Rothen, known for his contributions

to telegraphy; of Dr. Peter D. Keyser, an eminent ophthalmologist of Philadelphia, formerly professor of this subject at the Medical Chirurgical College and surgeon to the Wills Eye Hospital; of Dr. Olaus Dahl, professor of Scandanavian languages in the University of Chicago; and of Mr. Luther H. Tucker, editor of *The Cultivator and Country Gentleman.*

THE late Professor Tilanus founded a gold medal, to be given every five years by the University of Amsterdam for a contribution to medicine or natural science. It was conferred this year for the first time on Dr. Zwaardemaker, of Utrecht, for his work on 'Physiology of Smell.'

THE Paris Faculty of Medicine has awarded the Lacaze Prize of 10,000 francs to Professor Nocard, of Alfort, for his researches on tuberculosis.

PROFESSOR OSCAR LIEBREICH, director of the pharmacological laboratory of Berlin University, has received the officer's cross of the French Légion d'Honneur.

THE following further awards of medals are recorded in *Nature:* The Albert Medal of the Society of Arts to Professor David Edward Hughes, F.R.S., "in recognition of the services he has rendered to arts, manufactures and commerce by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone;" and a gold medal of the Société Industrielle du Nord de la France to M. Moissan, in recognition of his scientific investigations. The Royal Academy of Belgium has awarded gold medals, of the value of 600 francs, to Dr. C. De Bruyne, of Ghent, for his essay on the influence of phagocytes in the development of the invertebrata; to M. G. Cesàro, of Trooz (Liège), for his essay on Belgian minerals; to MM. J. F. Heymans and O. Van der Stricht, of Ghent, for their conjoint paper on the peripheric nervous system of *Amphioxus;* and to M. Jean Massart, for his essay on the cicatrisation of plants.

PROFESSOR E. E. BARNARD gave an illustrated lecture at Oxford University on March 1st. Sir Clements Markham will lecture before the London Royal Geographical Society on March 22d, on 'Some Considerations in Polar Explorations.'

PROFESSOR W. LECONTE STEVENS, of the Rensselaer Polytechnic Institute, has written to Professor J. K. Rees, of Columbia University, Secretary of Metrological Society: "For reasons which have been fully set forth orally, I regret that it will not be possible for me to accept the Secretaryship of the Metrological Society. My interest in the objects which the Society is endeavoring to attain is not on this account in the least diminished, and I shall continue to spend such time and exert such influence as I may be able to command in furthering these objects."

THE German government has appropriated 20,000 Marks for the investigation of the foot and mouth disease, and the work has been entrusted to Professor Lœffler, of Greifswald, and Dr. Frosch, of the Koch Institute.

PROFESSOR BENO ERDMANN, of Halle, has been awarded 600 Marks by the Berlin Academy of Sciences for researches in experimental psychology.

THE trustees of Cornell University will build for Professor Harris a naptha launch to be used for the transportation of students studying paleontology. It is expected to use the boat during the summer holidays for field work.

IT is reported in the *Engineering News* that the largest spectroscope in the world has just been completed by John A. Brashear, of Allegheny, Pa., the well-known astronomical instrument maker. It was made for the private research laboratory of Dr. Hans Hauswaldt, of Magdeburg, Germany. The instrument contains a concave diffraction grating with 110,000 lines per inch, made on the famous ruling machine of Professor Henry A. Rowland, of the Johns Hopkins University.

ANOTHER secret method of color photography has been recently exhibited in London, the exhibitor being this time an Englishman, Mr. Bennetto. The pictures are said to show colors very well, but until the nature of the process is explained the matter is scarcely one coming within the range of scientific discussion.

A BILL has been introduced into the Minnesota Legislature providing for the appointment of a State phrenologist, who must examine not less than 2,000 Minnesota heads annually!

THE Torrey Botanical Club and the College of Pharmacy of the City of New York offer two summer courses in botany: one on the general morphology of plants by Dr. W. Arthur Bastedo; the other on cryptogamic botany by Dr. Smith Ely Jelliffe. The courses will be given at the College of Pharmacy, beginning March 25th and 26th, respectively, and in connection with them weekly field excursions have been arranged, lasting from April 24th to June 12th.

FOUR hundred Cossacks have been sent to the Russo-Persian frontier to establish a military cordon for the enforcement of quarantine to prevent the introduction of the plague into Asiatic Russia.

A SECOND international Congress of Sanitation and Hygiene of Railways and Navigation will be held at Brussels during September, 1897. The preceding Congress at Amsterdam was of scientific interest, and the next Congress has the support of the Belgium government. Those wishing to attend the Congress or obtain information regarding it should apply to Dr. J. de Lantsheere, rue de l'Association 56, Brussels.

THE Council of the American Geographical Society has adopted the report of a committee consisting of Judge Charles P. Daly, Admiral Gherardi and Mr. Chandler Robbins, endorsing the plan of Lieutenant R. E. Peary, proposing to devote a number of years to complete the exploration of the unknown region between Greenland and the North Pole. The Council recommends that the Society subscribe toward the expense of his next expedition, provided that such subscription is needed, and the full amount to carry out the enterprise is subscribed.

THE Geographical Club, now the Geographical Society of Philadelphia, during the month of February, 1896, transferred all its books and exchanges to a large room it had rented for a library. But a few days later the building was entirely destroyed by fire, and the Club lost all its possessions. It has only now been possible to make a fresh start, and all the books and exchanges which have been received since the fire and have been stored away have been transferred to the new rooms at 1520 Chestnut street. The Society would be glad to receive publications bearing upon geography.

Nature reports that Dr. Arthur Willey, who worked out the later development of Amphioxus when he was a pupil of Professor Ray Lankester at University College, London, has just made a most important discovery. He has succeeded in obtaining the ripe eggs of the Pearly Nautilus, and is now at work on the development of that most interesting animal. Two and a half years ago Dr. Willey gave up a position in Columbia University and accepted the Balfour Studentship of the University of Cambridge, in order to proceed to the coast of New Guinea and neighboring islands in quest of the embryological history of the Pearly Nautilus. He has had great numbers of live nautilus, but, in spite of all efforts, had, till December 5th last, failed to obtain the eggs. Specimens which he was keeping in a large cage, sunk in the sea at a suitable spot in the Loyalty Islands, were found by him on that day to have spawned. Dr. Willey's indomitable perseverance and devotion to his task have thus been at last crowned by success. Dr. Willey has been assisted in his arduous and dangerous enterprise—amongst the savage people of those remote islands—by grants of money from the Government Grant Fund administered by the Royal Society.

MR. PALMER, the New York Secretary of State, has drawn up a report showing that the total number of convictions in the New York courts was 66,420 in 1896, as compared with 71,480 in 1895 and 68,146 in 1894.

ACCORDING to the *British Medical Journal* the medical faculty of Montpellier is authorized to accept the important legacy bequeathed to it by the widow of Dr. Bouisson, which is as follows: The Grammont chateau and grounds to be devoted to the creation of a scientific and humanitarian establishment; also the furniture and linen belonging to the chateau; the interest of $60,000 to be applied to defray the expenses of the establishment; a chapel to be built under the supervision of the executors; the interest of $9,000 to be given as a salary to the priest attached to the establishment. All the instruments, and the drawers containing them, likenesses, manuscripts belonging to the late Dr. Bouisson and Dr. Bertrand, the husband and father of Mme. Bouisson, and a marble bust of

Dr. Bertrand, are likewise included in the legacy.

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. E. A. STEVENS, widow of the founder of the Stevens Institute of Technology, has given the Institute land adjacent to it valued at $30,000.

THE Trustees of the University of Pennsylvania have petitioned the Legislature for an appropriation of $1,000,000 in aid of the University, conditional upon the raising of an equal amount by the friends of the institution.

EUREKA COLLEGE, in Illinois, is said to have received in subscriptions $150,000, of which some $20,000 was given by Mr. T. E. Bondurant, of Deland, Ill.

THE annual catalogue of Princeton University shows that the number of students is 1,045, as compared with 1,088 last year. There are 548 students in the academic department, 374 in the school of science, 115 graduate students and eight fellows.

THE following promotions have been made at Cornell University: Louis M. Dennis has been appointed professor of analytical chemistry; Walter F. Willcox, professor of sociology; Henry S. Jacoby, professor of civil engineering; John Henry Barr, professor of machine design, and Joseph E. Trevor, professor of physical chemistry.

CHRISTOPHER W. HALL, professor of geology and mineralogy and Dean of the College of Engineering, Metallurgy and the Mechanic Arts in the University of Minnesota, has been granted a leave of absence for the year beginning next September. Professor Hall has resigned the office of Dean, which will be abolished. A reorganization of the College has been voted; the departments of civil, mechanical and electrical engineering will constitute the College of Engineering and Mechanic Arts; the departments of mining and metallurgy will constitute the Minnesota School of Mines, and the course in chemical engineering will become a course in pure and applied chemistry in the College of Science, Literature and the Arts, for which the degree of B. S. will be given.

A MEETING of the delegates from the institutions named in the report of the Cowper Commission was held on March 25th. Lord Lister, the President of the Royal Society, moved the following resolution: "That this meeting of delegates represents to her majesty's government the great injury caused to the educational interests of the metropolis by the delay in establishing a teaching university for London, and urges upon them the necessity of taking immediate steps for the constitution of a statutory commission for the reconstruction of the University of London on the lines of the recommendations of the Cowper Commission." The motion was seconded by Professor Rücker and carried unanimously. Remarks in support of the resolution were made by Lord Lister, Sir George Young, Sir Henry Roscoe, Rev. Dr. Wace and Lord Reay. The latter said, according to the report in the London *Times*, that it was most disheartening that the delegates should have to meet again. In no other country in Europe would such a company of distinguished men of science and of learning have urged on its government the necessity of founding a teaching university without its at once acceding to their wishes. We in England were being watched from abroad. Foreign nations formed their opinion regarding our advance in civilization by the action of Parliament in reference to the reconstruction of the University of London. The House of Lords had done its duty; last year the bill was passed unanimously. The mischief was done in the other House. The government had appointed a chairman to the proposed commission; its honor and that of the country was engaged in bringing the matter to a successful issue. It was a court of arbitration that was required, a court which would tend as much towards the progress and honor of the country as the recently formed court of arbitration with the United States.

DR. KARL KAISER has been promoted to an associate professorship of physiology in the University of Heidelberg, and Dr. Karl Fütterer to an associate professorship of mineralogy and geology in the Polytechnic Institute at Karlsruhe.

DISCUSSION AND CORRESPONDENCE.

THE FLORIDA SEA-MONSTER.

SINCE the publication of the brief note in SCIENCE, March 5th, I have made additional studies of the specimens received, which confirm the cetacean affinities more definitely. The extreme firmness and toughness of the thick elastic masses of integument show that the structure must have been intended for resistance to blows and to great pressure, and could not have pertained to any part of an animal where mobility is necessary. They are composed of a complex of strong *elastic* connective tissue fibers, like those of cetaceans. There are *no muscular fibers* present in any of the parts sent. This lack of muscular tissue and the resistant nature of the integument are sufficient to show that the creature could not have been a cephalopod, for in that group a highly contractile muscular tissue is essential.

The structure found is closer to that of the integument of the upper part of the head and nose of a sperm whale than to that of any other structure known to me. It is probable, therefore, that the great bag-shaped mass represents nearly the whole upper part of the head of such a creature, detached from the skull.*

A rough area, shown in the latest photographs of the under side of the upturned mass, may indicate the area that was attached to the skull. It may have belonged to a very large example of a common sperm whale, with an abnormally developed and perhaps diseased nose; if not, then it probably pertains to some entirely unknown creature of the same family. It seems hardly probable that any such large cetacean remains to be discovered. The shape of the mass, and especially of the large, round, closed end supposed to represent the nose, is quite unlike the head of the sperm whale, which is truncated high and narrow in front and projects but little beyond the upper jaw. Moreover, nothing corresponding to the blowhole of a sperm whale has been discovered. Some of the photographs show an indentation near the large end on the upper side, but Dr. Webb informed me that it was only a pit or 'sulcus' about two feet long and six inches deep, perhaps due to injury. The internal cavity, so far as made out, seems to be unlike that of the sperm whale. Therefore, the view that it may be from an abnormal or normal sperm whale must be regarded as a supposition or theory that still needs more evidence to support it, but is at present the most plausible.

A. E. VERRILL.

NEW HAVEN, March 12, 1897.

* This view has been adopted by me in an article now in type for the next number of *The American Journal of Science.*

THE FLORIDA MONSTER.

PROFESSOR VERRILL would be justified in making a much more emphatic statement (see SCIENCE for March 5th) than that the structure of the masses of integument from the 'Florida monster' resembles blubber, and the creature was probably related to the whales. The substance looks like blubber, and smells like blubber and it *is* blubber, nothing more nor less. There would seem to be no better reason for supposing that it was in the form of a 'bag-like structure' than for supposing that stumps of arms were present. The imaginative eye of the average untrained observer can see much more than is visible to anyone else.

F. A. LUCAS.

WASHINGTON, D. C., March 8, 1897.

GIBBERS.

OBSERVERS the world over have reported, in wind-swept places, the occurrence of pebbles having carved and polished surfaces due to the action of the natural sand blast. German geologists first called these pebbles 'Kantegerölle,' from the edges ground on them by intersecting planes of wear. Walther next proposed to call them 'facettengerölle,' because the facets were the essential features, the edges resulting from the development of the planes. But not all sand-blasted pebbles are facetted. Planes and edges are not more common than concave surfaces and pits; or, as Gilbert found in the Wheeler Survey, a vermicular fret-work wear of the rock surface. For these reasons the name 'glyptolith' was proposed by the writer in an account of the pebbles seen in southern New England. (Am. Jour. Sci. XLVII., 1894, pp.

63–71.) At the time there was no English equivalent to German usage.

W. A. Horn, in *The New Illustrated Magazine* (London, March, 1897, pp. 597–605), gives a vivid description of the Eremian or Solitary Desert region of Australia. The surface of this deflated plain is described as strewn with "bare shining stones, having a polished surface, from the sand continually blowing over them. They are locally known as 'gibbers' (hard g.)." Those who have occasion to employ a name for such pebbles now have an extended choice of German and Greek compounds and English gibberish.

J. B. WOODWORTH.

HARVARD UNIVERSITY.

INTERNATIONAL CONGRESS OF MATHEMATICIANS AT ZURICH IN 1897.

"IT is known that the idea of an international congress of mathematicians has been, above all in these latter days, the object of numerous deliberations on the part of scientists interested in its realization. It has appeared to them, by reason of the excellent results obtained in other scientific domains by an international 'entente,' that assuring the execution of this project would have very weighty advantages.

"As the outcome of a very active exchange of views, accord was reached on a prime point. Switzerland, by its central geographic situation, by its traditions and its experience of international congresses, appeared designated to invite a first attempt at a reunion of mathematicians. In consequence Zurich is chosen as the seat of the congress.

"The mathematicians of Zurich do not disguise from themselves the difficulties they will have to surmount. But in the interest of this enterprise they have thought it their duty not to decline the flattering overtures that have been made them from all sides. They have decided, therefore, to take all preparatory measures for the future congress and, to the extent of their powers, to contribute to its success. So, with the concurrence of mathematicians of other nations, was formed the undersigned committee of organization, charged *to bring together, at Zurich in 1897, the mathematicians of the entire world.*

"The congress, in which you are cordially invited to take part, will take place at Zurich the 9th, 10th and 11th of August, 1897, in the halls of the Federal Polytechnic School. The committee will not fail to communicate to you, in time, the text of the program determined, begging you to inform them of your adherence. But even at present it may be said that the scientific contributions and questions of policy will pertain to subjects of general interest or recognized importance.

"Scientific congresses have also this great advantage, to favor and keep up personal relations. The local committee will not fail to give great care to this part of its task, and, with this aim, it will arrange a program of fêtes and social reunions.

"May the hopes reposed in this first congress be fully realized! May numerous participants contribute by their presence to create, among colleagues, not alone coherent scientific relations, but also cordial bonds based on personal acquaintance!

"Finally, may our congress serve the advancement and the progress of the mathematical sciences!"

The invitation of which the above is a translation is signed by eleven from Zurich and ten associates, as committee.

Readers of SCIENCE already know of the persistent efforts of Vasiliev, of Kazan, and Laisant, of Paris, to establish this congress. It is matter for rejoicing that their noble endeavors have been crowned with this definite successs.

GEORGE BRUCE HALSTED.

A NEW GEOGRAPHICAL MAGAZINE.

THE appearance of a new geographical magazine* is a matter for both congratulation and regret. The magazine referred to is designed to furnish authentic and well-selected geographical data for the use of school teachers, and the opening number gives promise that much good may be expected from it in this direction. The articles presented seem well adapted to the audience addressed and are scarcely open to

* *The Journal of School Geography.* R. E. Dodge, responsible editor; W. M. Davis, C. W. Hayes, H. B. Kümmel, F. M. McMurry and R. DeC. Ward, associate editors. Published at Lancaster, Pa. Price, $1.00 a year.

criticism, when the special aim of the publication and the space available are considered. It is not so much the subject-matter contained in the new magazine, or the dress in which it appears, however, as the future of the enterprise and the demands of geography in America that suggest remarks.

If the teachers in our schools will support a magazine devoted to the pedagogical phases of geography there is certainly a broad field open to Professor Dodge and his able associates, but unless the new magazine has such financial support as to be practically independent of the returns received from subscribers, one can scarcely expect it to be long-lived. Other geographical magazines have germinated in this country, blossomed for a short period and, for want of financial support, died or passed to a condition of 'innocuous desuetude.' There is nothing in the appearance or character of the new effort to indicate that it possesses greater vitality than its predecessors.

In addition to the geographic magazines referred to, at least six of the geographical societies of the United States are engaged in publishing magazines and journals. None of these publications are widely known or are exerting an important influence on the development of geography. None of them can be said to have a high standard or to make a near approach to what may reasonably be considered as an ideal geographical magazine.

Instead of welcoming an addition to the number of but little known and far from successful publications already existing, with which the *Journal of School Geography* claims a place, it is for many reasons rather to be wished that the number might be materially decreased and the survivors strengthened.

If our several geographical societies could be induced to put aside what are considered local interests and unite in issuing a single, strong, well-edited and attractively-illustrated monthly magazine, in which the proceedings of the several societies could be reported and the best papers read at the local meetings be published, a great gain would certainly result. Such a plan would do away with duplication in the printing of reviews, current notes, etc., and furnish the members of the affiliating societies with a wider range of reading matter, probably with a decrease in expense, than is afforded by the present system of multiple publication. An *American Journal of Geography*, in fact as well as in name, published under the auspices of the geographical societies of America, would be welcome in many libraries where scarcely one of the present publications referred to finds a place. The proposed magazine, being supported directly by several societies, would be furnished to each of their members, thus securing a circulation at the start of at least 4,000. The subscriptions of teachers and those interested in geography, but residing at a distance from the cities where geographical societies exist, would largely increase this number. A section devoted to *studies for teachers* would fill the place claimed for the journal that has just appeared.

The good that such a magazine as here suggested might accomplish by reaching a larger audience, furnishing them with more varied and more carefully selected reading matter, and by maintaining a higher standard than the existing geographical publications in this country, would certainly be far greater than under the present system.

The proposed magazine might be placed under the general management of the presidents or secretaries of the affiliating societies, but the responsibility for its appearance and standing should rest with a paid editor. Possibly, also, compensation should be offered for special articles in order to keep abreast of the times and furnish opportunities to those who could not afford to give their services.

The deleterious results of diffused and frequently antagonistic efforts in publication, are painfully apparent in the low grade of many of our newspapers and popular magazines. This almost inevitable result of multiple publication may be avoided in geography by a union of interests.

ISRAEL C. RUSSELL.

COMPLIMENT OR PLAGIARISM.

Now that Professor Halsted has made use of three issues of SCIENCE to prefer and establish charges of plagiarism against us, it may be well to make a comparison of the charges with the evidence as brought out in the discussion.

In his first article he says: "Without the slightest word of acknowledgment these professors [Beman and Smith] '*took*' a whole block of problems and a long note from Halsted's Elements of Geometry;" or, as he puts it more picturesquely in another place: "[They] have paid Dr. Halsted's Elements of Geometry the startling compliment of appropriating bodily Book IV., Section I., Partition of a Perigon (pp. 151–154), in their Geometry, pp. 179–181; Ginn, 1895. Elementary Geometry has been the most stable part of all science. The introduction into it, by Dr. Halsted, of the section entitled Partition of a Perigon was an utter innovation. The section, and even the very phrase 'Partition of a Perigon' had never before appeared in the world. This being the fact, the following 'deadly parallel' shows a psychologically interesting ethical color-blindness on the part of two teachers not otherwise known to have been openly immoral." Then follows a comparison of the two books, omitting the 'long note,' which seems to have disappeared from the controversy.

We have shown that the *order* of these problems is a perfectly natural one and not original with Professor Halsted. We have shown that the *solutions* of the problems in the two books are not the same. We have shown that Professor Halsted took the word 'perigon,' on which so much stress has been laid, from Sandeman's Pelicotetics without acknowledgment, and yet he affirms that "their [our] * researches on this matter turn out highly complimentary to me [him];" and that "our having reason to believe that W. B. Smith, Newcomb and Faifofer all did see the word for the first time in Halsted's books * * * surely * does me [him] great honor." Evidently "honors are easy."

That Professor Halsted furnished the facts given on page 237 of Cajori's Teaching and History of Mathematics in the United States we are not inclined to deny, but we look in vain for the slightest reference to the word 'perigon' or its origin.

That the phrase 'Partition of a Perigon' occurs only in Halsted's book and our own is true—so far as we know—but surely the notion is not so original that Professor Halsted would claim it as his personal property. Compare Henrici und Treutlein, Lehrbuch der Elementargeometrie, 1881, p. 91: "Denkt man den Vollwinkel [Vollwinkel-perigon] * * in n gleiche Teile geteilt;" and again, "Teilt man den Vollwinkel in n gleiche Teile." If this does not suggest 'Partition of the Perigon,' how would the idea be expressed in German?

In the preparation of our geometry we made considerable use of Henrici und Treutlein and in our preface we mention it first among the helps employed; with respect to the sources of his material it is not the habit of Professor Halsted to take the public into his confidence. How familiar he may have been with this book we do not know.

In answer to his last question we might say that Professor Beman saw Sandeman's Pelicotetics for the first time in the Peabody Institute library at Baltimore in February, 1882, and secured a copy for his private library that same year.

With this summing up of the evidence we cheerfully submit the whole question to the intelligent jury of readers of SCIENCE, feeling absolute confidence as to the verdict that will be rendered.

BEMAN AND SMITH.

[As the charges were first brought by Professor Halsted, it seems best to close the discussion with the reply from Professors Beman and Smith.—ED.].

MEXICAN HIEROGLYPHS.

TO THE EDITOR OF SCIENCE: I have received the following note from Mrs. Zelia Nuttall, an expert in all that pertains to Mexican hieroglyphs, in which she shows that figures 114 and 115 of my paper in United States National Museum Report, 1894, Pp. 623–726, were not, as I supposed they might be, figures of drills. The fire drill in all countries is similar to the drill employed in making holes through hard minerals and wood. Mrs. Nuttall's correction makes it probable that the North American nor the South American either of them know other than the straight shaft.

J. D. MCGUIRE.

Fig. 114 is a copy of the hieroglyph of the town Huitzoco taken from the Codex Mendoza, p. 39, fig. 4. (See text of Codex Mendoza,

Vol. V., Kingsborough.) The fact that it was employed in pictography to express the sound *Huitzoco* proves that the object depicted is a 'Huitzoctli,' described in Nahuatl dictionaries as 'a staff of oak, used as a lever to upturn sod or earth—a digging pole.' The figure placed across the staff is the emblem of the pulque (octli) gods and expresses here the *octli*. It offers another interesting illustration of the employment by Mexican scribes of complementary signs, in order to render the meaning of a hieroglyph unmistakable; a usage I had detected and published about 1886 (see Standard on Headdress? Peabody Museum, Papers, Appendix).

From the foregoing it is evident that, instead of a possible drill, the hieroglyph represents the digging staff, employed for its phonetic sound with a complementary sign determining it, thus: huitzoctli word expressing name *Huitzoco* (octli), complementary.

Fig. 115 is the hieroglyph of the town, Tlachmalacac (see, also, text of Codex Mendoza). This word explains to us that the signs are representations of 1, the *tlachtli*, not 'a possible frame,' but the groundplan of the court employed for the national game of ball, or tlachtli. This sign is well known, and frequent examples of its employment to express the sound *tlach* are to be seen in the same Codex Mendoza; see, for instance, plate 33, fig. 2, and plate 38, fig 1, where the name of the town of *Tlachco* is expressed in picture writing.

See also plate 22, fig. 4 (town *Tlach*yahualco), and plate 47, fig. 3, *Tlach*quianhco, expressed by the sign tlachtli, within which are raindrops—quiachuitl. The affix *co* means *inside of* and is expressed by the rain being represented *inside* of the tlachtli. The object represented on the tlachtli sign is a spinning-wheel, a *malacatl*; it has nothing to do with the *tlachtli* and is only employed to express its own sound.

Figs. 100 and 116 are *both* representations of priests kindling the New Fire at the beginning of a new cycle, a ceremonial observance.

Fig. 116 shows how the *themaitl*, or fire drill of wood, was employed to kindle fire in a log or large piece of prostrate wood; a fact that does not at all contradict Mr. McGuire's interesting observation that, doubtless, the Mexicans employed the same kind of drill for boring wood.

ZELIA NUTTALL.

THE PLAY OF ANIMALS; THE FUR SEAL.

IT was with some little pleasure that I read the review of Professor Gross' *Die Spiele der Thiere* in SCIENCE for February 26th, and found that he holds play in animals 'to be an instinct developed by natural selection, * * and to be on a level exactly with the other instincts which are developed for their utility.' The pleasure lay in the fact that having ventured into the (to me) foreign domain of psychology, I had written as follows: "The great redeeming feature of the fur-seal's character is its playfulness when young, for few animals seem to enjoy life so well as the rollicking pups and young bachelors. But here again it is necessary to curb our imagination and to remember that while the young seals undoubtedly do derive a certain amount of enjoyment from their sports very much of what strikes us as mere play is in reality dawning instinct. The sporting of seal pups foreshadows the time when their very lives will depend on the ability to capture food for themselves, and the playful wrestling contests in which they perpetually engage are mere hints of future fierce battles among bulls. Yearlings do not 'round up' harems of pups with the reasoning care that a child bestows on her dolls, but because centuries of heredity have caused this instinct to be developed long before it serves any practical purpose." As the young seals do not associate with the old, their play would seem to be purely instinctive. The conclusion derived from this study of the mental traits of the fur seal and its direct bearing on the questions at issue is that "this acting by instinct is the keynote of the seal's character; the mind, like the body, has been molded by natural selection acting on the mass, so that one seal behaves like another and knows just as much as another, and no more. It is a creature of instincts and not guided to any great extent by reason; as it has done in the past so it will do in the future; its habits being formed by the slow process of natural selection can change but slowly; hence the fur seal is not likely to alter its habits nor to adapt itself to changes in surrounding conditions."

F. A. LUCAS.

SCIENTIFIC LITERATURE.

Electro-Physiology. By W. BIEDERMANN, Professor in Physiology in Jena. Translated by FRANCES A. WELBY. Macmillan & Co., London and New York. 1896. Vol. I. Pp. 522.

The perusal of such a work rather 'takes it out of one' under the most favorable conditions. With regard to the present treatise, a great deal may be said in praise of the patience with which the material has been collated, and the soundness of the conclusions which have been drawn from experimental facts. Indeed, the scientific independence of the author is evinced in the homogeneity of the work, which is far from being a mere compilation. On the other hand, the intrinsic difficulties of the subject are much increased by the labored style of their presentation; the sentences are frequently huge in length, and the noun substantive is commonly required to be carried in mind through several successive paragraphs. The pedagogic error, so common with investigators, of presuming too much on the ability of the student to read between the lines, is here too constantly illustrated. Another practical defect of the work is the lack of topical subdivisions of its subject-matter, by which device the reader might have been enabled to refer at once to any desired point of the discussion. Also, in a book designed chiefly for the use of investigators, a more complete bibliography of the subject than that which has been given might fairly have been expected. In all these respects the work is far less admirable than that which pertains to the same subject in Hermann's *Handbuch der Physiologie*, published seventeen years ago, and is much inferior in the presentation of its histological sections to the corresponding parts of *Quain's Anatomy*.

The name 'Electro-Physiology,' by which the book is announced, is ill-chosen and by no means denotes its scope, as is evidenced by the following chapter divisions of the subject:

1. Organization and Structure of Muscle, pp. 51.

2. Change of Form in Muscle during Activity, pp. 199.

3. The Electrical Excitation of Muscle, pp. 156.

4. Electro-motive Action in Muscle, pp. 122.

5. Electro-motive Action of Epithelial and Gland Cells, pp. 57.

After giving due weight to these criticisms, it is only fair to say that, since the appearance of Hermann's *Handbuch*, there has been no such approach to providing the student of physiology with a complete exposition of present knowledge of the field covered, as is made by this treatise of Biedermann.

When the reader has become familiar with the intricacies of his style it is clearly seen that the author is master of his subject; he has succeeded to a singular degree in linking his data into a continuous story, which, now and then, is summarized to show what general truths have been gained and whither they lead. It is the opprobrium of our knowledge of nerve-muscle physiology that, though its study has developed a vast number of experimental facts, it is well-nigh impossible to sift those that pertain essentially to the living organism from those of purely instrumental origin. Professor Biedermann, while giving full treatment of the experimental processes lying at the base of his conclusions, has done much towards providing a philosophical exposition of our knowledge. The author is at his best the greater the intrinsic difficulty of the subject he expounds; while, *e. g.*, his description of the comparative histology of muscle lacks much in clearness, his account of the intricate optical changes undergone by the contracting tissue is admirable. The statement, p. 55, that a single muscular twitch is characterized by 'rapid contraction, with much slower subsequent elongation,' is certainly misleading as regards the action of fresh muscle under tension. The so-called 'latent period' of muscular excitement, or the time elapsing between the application of a stimulus and the beginning of muscular shortening, which was first announced by Helmholtz to have the value of about .01 sec., has gradually been reduced by subsequent investigators.

The author's discussion of this subject is one of his best. It is strange, however, that the mechanical factor involved in the latent period is neither here nor in other works more clearly expressed. As the strength of a single stimulus is gradually increased, so as to produce a series

of contractions varying from minimal to maximal in amplitude, the latent period is observed to become progressively shorter. The weaker waves of submaximal contraction do not pass through the full length of the muscle, and the unexcited part of the tissue acts simply as an elastic band whose tension must be increased to a definite degree before visible shortening of the whole muscle can take place. It can readily be seen that the time lost through the extensibility of the uncontracting part of a muscle fibre largely accounts for the 'latent period of stimulation.' The adjective 'Subliminal,' used by the translator to express a stimulus too weak to excite contraction, is not to be found in Webster.

Errors of type and expression in the work are not numerous; but in the figures of tracings representing the effect of rest on the curve of muscular fatigue the increased height in the contractions immediately following an interval of rest is not represented. Also, on page 540, the terms hilus and hilum are used indifferently.

Certain views which are implied, rather than expressed, should not be admitted without specific inquiry. Thus, the author assumes a likeness in kind between those summations of stimuli, each stimulus by itself being ineffective, which, on the one hand, produce tetanus in certain slowly moving muscles, and, on the other, cause reflex action from the spinal cord when applied to a sensory surface (p. 119). It is a satisfaction to find, at last, an author who gives true value to current *density* as a physiological stimulus rather than to current *intensity*; a current of given intensity has very different stimulating powers according as it is led to the tissues through broad or narrow electrodes. To the younger student, the explanation that physiological kathode, or point of excitation by the electric current, is at the place where the current *leaves* the irritable tissue, will clear up many obscure results of experiment. The author draws, perhaps, too close an analogy between the polar excitation effects shown by some protozoa on the passage of a constant current through them and the excitatory phenomena of muscle and nerve. There is nowhere to be found a more complete discussion of du Bois-Reymond's law of the excitation of irritable tissues. The law asserts, in brief, that it is not the absolute intensity of the stimulus which determines its irritating value, but fluctuation in intensity. Biedermann shows that the prolonged contraction manifested by muscle during the passage of a constant current through it forms no true exception to the law. He also calls attention to a needed amendment to du Bois-Reymond's law, in that "not merely the *local* changes at the seat of excitation, but still more the propagation of the excitatory process, *i. e.*, the discharge of a wave of excitation (contraction), are dependent upon the *variations* of current intensity, and the steepness of the same, in the case of tissues in which conductivity is adequately developed. The 'universal law of excitation' refers, therefore, less to the manner of the excitatory process, and effectuation of the changes of the excitable substance fundamental to it, *at the seat of direct excitation* (physiological anode and kathode), than to the conditions of the propagation of the excitatory process by conduction" (p. 314).

It is a disappointment to find that, as yet, there is little light to be shed upon the relations between the excitatory and contraction waves of muscle.

Much abtruse and technical literature would have to be culled in order to reach the results so ably summarized in the sections on electromotive action in muscle; particularly satisfactory are the pages devoted to the 'Positive variation of the muscle current.'

It is a worthy reward for all the thought and labor that for nearly fifty years have been devoted to electro-physiology, to find that here the facts are pointing to a physiological generalization which was first conceived in another field of the science. A decade ago Gaskell, as the result of a masterly series of researches, concluded that to each contractile tissue there were supplied two forms of nerve fibre, a motor and an inhibitory branch, the former exciting to functional activity and the latter bringing the organ to rest. As motor action, representing evolution of energy, is a result of chemical disassimilation, so inhibition is coincident with absorption of energy by a tissue and its chemical change is one of assimilation. This theory, arrived at by a study of the phenomena

of muscular contraction, is now supported by results obtained through the study of the electrical changes set up in muscle by artificial stimulation. In brief, the chemical changes of disassimilation, coincident with functional activity, which are brought about by stimulation of the motor nerve, cause the active part of the tissue to become electro-negative to the resting part.

On the other hand, certain other efferent nerves, having an inhibitory effect, cause, when stimulated, the part of the muscle under their influence to become electro-positive to the resting part. In all probability these nerves also excite chemical assimilation and the absorption of energy.

It is approaching an anti-climax to turn from such a conception as this to the arid field of glandular electricity. Here the mechanical difficulties in the way of experimentation have affected the purity of results to such a degree that little of physiological importance can, as yet, be predicated from the work. In conclusion, a word of admiration is due the translator to whose fortitude we are indebted for this work in its present form. The rendition seems, for the most part, to be excellent; and the bookmaking by Macmillan is, of course, of the best.

HENRY SEWALL.

UNIVERSITY OF DENVER.

The Coming Ice Age. By C. A. M. TABER. Geo. H. Ellis. 1896. Pp. 94.

The difficulty of accounting for the Glacial period is so great and the disagreement of glacialists is so profound that one cannot but welcome any sincere effort to shed additional light upon the subject. Especially is one inclined to give a candid hearing to an experienced navigator who has been led to study the effects of ocean currents upon climatic conditions. Such is the author of this little volume, who, in his extensive voyages had his attention directed to the subject at an early date, and in later years has made his personal observations the basis for collecting a large body of facts otherwise attainable.

The theory of the author is that a land connection between Patagonia and the Antarctic Continent, or a great diminution of the channel between those lands, would produce an effect upon oceanic currents favorable to the glaciation of both hemispheres. In supposing such a land connection he is in company with many zoologists who have inferred the same from the unique distribution of the plants and animals of the southern hemisphere.

Assuming this extension of land from Patagonia to the Antarctic Continent, the effect upon the currents would be, according to the author, as follows: The prevailing westerly winds in the south temperate zone would pile the waters up against the western side, and would drive them away from the eastern side of the southern part of this continent. The shape of the continents and the general direction of ocean currents are such that during this condition of things there would be a movement of water towards the south pole in excess of that moving toward the north pole. This accumulation of water about the south pole would be increased by the attraction of the water until there was a submergence of the isthmus connecting Patagonia with the Antarctic Continent, such as to allow a free passage from the higher levels of the Pacific to the lower levels of the Atlantic in that latitude. This water from the Pacific, being a cold current, would displace that which had formerly been drawn down from the tropics on the east side of South America, and thus lower the temperature of the Antarctic Continent and produce conditions favorable to glaciation, such as exist at the present time. These conditions he believes to be cumulative.

This very general statement of the theory passes over many details, and it may be that it does not in all respects fairly represent the author's views. But we are compelled to confess that his style is so obscure, and his digressions are so frequent, that we have found it difficult to be sure that we have comprehended his meaning. The author's confidence in the stability of the earth's crust is such that he is not willing to grant the moderate changes of level in the sea-bottom south of Patagonia which would be necessary to secure the submergence there which his theory demands; therefore, he is compelled to throw the whole burden upon the winds and the augmenting attraction of the

accumulating water. But it is difficult, not to say impossible, to believe that these forces would be adequate to the production of any such results as he supposes. The total amount of displacement which could result from them could be only a few feet.

Combined with the theory of moderate oscillations in the earth's crust at the proper places, Captain Taber's views are helpful in appreciating the effect of the ocean currents in so distributing heat and moisture as to produce glacial conditions both in the southern and northern hemisphere. But, unless he admits these changes of land level, we see little force in his arguments, and consequently his prognostication of a coming ice age is without any scientific basis.

G. Frederick Wright.

Researches upon the Antiquity of Man in the Delaware Valley and the Eastern United States. By Henry C. Mercer. Ginn & Co., Boston. 1897. 8vo. Illustrated. Pp. 178.

This volume is one of the series in 'philology, literature and archæology' published by the University of Pennsylvania. They are not intended to be 'popular,' but to convey the products of original research work. Such is the character of the present number. It is a plain and careful description of a series of studies conducted in the last few years, with the object of finding out whether there is sufficient evidence in the locality selected to assert that man lived there in the glacial or early post-glacial period.

Such assertions have been and are confidently advanced by several prominent American archæologists, especially with reference to the exhumation of chipped stones from the glacial gravels at and near Trenton, New Jersey.

On this particular point Mr. Mercer's personal researches are negative. His repeated examinations of the Trenton grounds 'failed to reveal a specimen in place' (p. 32); the caves he examined along the Delaware river contained nothing of man's handiwork which pointed elsewhere than to the Indian as we know him; and the so-called 'turtle backs' of argillite, found in the Trenton gravels, were probably 'intruded by modern Indians' (p. 60); and, finally nothing was found 'to corroborate the alleged antiquity of the chipped blades from Trenton,' and not a little to weaken it (p. 85).

These results, though in a measure negative, leave the supporters of the 'glacial man' theory at Trenton, with a large fraction of their argument exploded, since much has been made of the 'argillite implements' as proving antiquity. Now we know that whole quarries of argillite were worked by the modern Indian.

Other essays in the volume describe the exploration of an Indian ossuary on the Choptank River, Maryland, with a description of the physical characters of the bones by Professor Cope, and a discussion of their diseased (probably syphilitic) conditions by Dr. R. H. Harte; investigations by Mr. Mercer in an aboriginal shell heap on York River, Maine, in which traces of cannibalism were discovered; and excavations at the 'Indian house' and at Durham Cave, by the author. Among other interesting facts which Mr. Mercer has been enabled to substantiate by those studies is that in long post-glacial times the peccary, the tapir, the mastodon and the fossil sloth (*Megalonyx*) roamed the forests of the eastern United States. This, however, 'refers to an epoch in the past removed by many milleniums from the discovery of America' (p. 175), in the author's opinion.

The earlier pages of the volume recite several important investigations of the author in the 'quaternary' deposits of France and Spain. These gave him an excellent standard of comparison in his American work and the thoroughly scientific manner in which he carried it out is visible on every page.

There are a number of accurate and well-taken illustrations of localities and specimens, and the notes will aid the student in gaining access to the literature of the subject. It is to be regretted that no index was prepared.

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC JOURNALS.

PHYSICAL REVIEW, MARCH–APRIL.

The Lead Cell: By B. E. Moore. The extension of the theory of free ions, solution ten-

sion and asmotic pressure to the lead cell was first made by Le Blanc. This theory is farther developed in the article. The number of tetravalent lead ions at the positive plate of a charged lead cell is very small. When a current is taken from the cell, $PbSo_4$ is formed when the point of saturation of bivalent lead ions is reached. If the formation of such a product involves time, a supersaturation of bivalent ions would rapidly follow. This is especially true if the current is large. Upon the Nernst theory this would produce a rapid fall in the electro-motive-force of the cell, until equilibrium is produced, *i. e.*, until the rate of precipitation of the lead sulphate is equal to its rate of formation. In the charging process there would be a corresponding diminution in the products of ionization, and the charging electro-motive-force must rapidly rise above the normal electro-motive-force of the cell. Experiment confirms these deductions from the Nernst theory, and shows that these initial changes take place largely within the first two minutes after closing, or after opening the circuit. Debarring this initial change in the cell, which causes large losses in energy, the curve of the electro-motive-force of the cell is shown to agree through a wide range with changes in electro-motive-force brought about by progressive changes both in the solution tension of the electrode and in the pressure of the ions. It is shown that Planck's thermodynamic treatment leads to the same deductions.

On the Influence of Electrification upon Surface Tension of Water: By E. L. NICHOLS and J. A. CLARK. In this paper an attempt was made to determine by quantitative measurements the change in the surface tension of liquids to which the well-known effect of electrification upon water jets, etc., is due. The method pursued was that of the water dropper. A reservoir from which the water drops proceeded was kept charged by the continuous action of a Holtz machine driven by an electric motor. A large battery of Leyden jars furnished the circuit with sufficient capacity to prevent rapid fluctuations of potential.

The electrification of the reservoir was measured by means of a form of an absolute electrometer; the temperature of the falling drops by means of a thermo-electric junction. The range of potentials was from zero to 11,000 volts. Beyond the latter value measurements became impossible because drops were no longer formed. The result of these measurements indicates that the surface tension falls off at first slowly, and then more and more rapidly as the potential rises, until at 10,000 volts it has been reduced to about one-half its value for the electrified liquid. No difference could be detected between the action of positive and negative charges.

On the Mechanical Conceptions of Electricity and Magnetism: By W. S. FRANKLIN. This paper develops detailed mechanical conceptions of various electro-magnetic phenomena, based upon the fundamental conceptions of Maxwell, with particular reference to the quantitative relations which hold among the various electro-magnetic quantities. Among other things, a minute description is given of the action which takes place in the region surrounding a Hertz oscillator.

On a Possible Development of the Idiostatic Electrometer: By C. BARUS. The idiostatic electrometer has not hitherto been developed to an extent comparable with the quadrant electrometer; yet it possesses the advantage that it introduces no foreign potentials to cooperate with those under investigation. The writer describes certain results obtained in an endeavor to perfect the idiostatic electrometer. The moving system was supported by a double bifilar suspension. The disc was made very light and protected by a guard ring. The excursions of the disk were observed by Michelson's refractometer. Thus in one case ten fringes passed for a single volt; estimating 0.1 fringe the sensitiveness thus became 0.01 volt.

Empirical Formulæ for Viscosity as a Function of Temperature: By A. WILMER DUFF. Several formulæ for the viscosity of liquids at different temperatures have been proposed. The writer classifies and discusses these and considers means of interpolation and extrapolation.

A synchronous Motor for Determining the Frequency of an Alternating Current: By GEORGE S. MOLER. This paper describes an exceed-

ingly neat instrument for determining the frequency of an alternating current. A small synchronous motor is connected through a train of gears to a dial which indicates the frequency direct. The apparatus is small and portable, the base being 14 inches long and the total weight being 8.5 pounds. It may be operated from a 16 candle-power lamp socket.

Lecture-Room Demonstration of Orbits of Bodies Under the Action of a Central Attraction: By R. W. Wood. The apparatus consists of an electro-magnet with a conical pole piece projecting through a horizontal glass plate covered with lampblack. A bicycle ball is shot out upon this plate; its path is traced and a permanent record of its motion is thus obtained. Various orbits were thus determined.

The Refractory Index of Water and Alcohol for Alcohol and Electrical Waves: By A. D. Cole. This short note calls attention to the fact that the writer in a previous paper had not ignored the absorption of the Medium.

New Books: *Higher Mathematics*, Merriman and Woodward; *A Primer of Quaternions*, Hathaway; *Alternating-Current Machinery*, D. C. and T. C. Jackson; *Transformers for Single and Multiphase Circuits*, Kapp; *Méthode et principes des sciences naturelles*, Brentano; *Elements of Electro-Chemistry*, Le Blanc; *Motive Power and Gearing for Electrical Machinery*, Carter; *Mathematical Papers read at the International Mathematical Congress, Chicago, 1893; Laboratory Manual of Inorganic Chemistry*, Williams; *Chemistry at a Glance*, Tuttle; *Inorganic Chemical Preparations; The American Annual of Photography*, Thorp; *Problems and Questions in Physics*, Matthews and Shearer.

AMERICAN GEOLOGIST, MARCH.

O. W. Crosby and M. L. Fuller present the results of their investigation as to the 'Origin of Pegmatite,' or giant granite. The intimate association and evident close connection of pegmatite with undoubted plutonic rocks, and their agreement with the latter in composition and relations to the inclosing formations, have led many writers to regard the pegmatite itself as of plutonic igneous origin. It is also not long since geologists were united in the conviction that these were true vein rocks, due to the deposition of the various component minerals from solution in open fissures or other preexisting cavities. Now, however, a decided drift in the opposite direction may again be noted, and recent literature indicates an approaching agreement in favor of the association of the pegmatites, in their genetic relations, with plutonic igneous rocks rather than with subterranean aqueous deposits. The authors conclude that the magma of pegmatite may be formed by normal magmatic differentiation in a boss, or large body of magma, both crystallization and the operation of different temperatures in various parts of the mass tending to increase the degree of hydration of the residuum about favorable centers. These magma residues may crystallize *in situ*, in the midst of the previously solidified normal granite, or they may suffer extravasation and crystallize in spaces in the parent rock or in the surrounding formations. Also, apophyses of the normal granite magma may invade highly heated, water-bearing formations, such as schists, and experience the necessary hydration for conversion into pegmatite magma.

The correlation papers on 'The Galena and Maquoketa Series,' by F. W. Sardeson, end with this number. The basis employed has not been the usual one of computation of percentages among the various beds, but the limits, range, distribution and variation of the commonest species has been taken.

'Evidence of Glaciation in Labrador and Baffin Land,' by R. S. Tarr. All of the land, excepting possibly the highest parts, has been buried beneath an ice sheet. The glacial action produced more effect in the down-cutting of the surface in Labrador than in Baffin Land, and there is evidence that the ice has withdrawn from these regions in very recent times. Ice erosion has been greater in New England than in the northern region. On the other hand, proceeding northward, the effects of post-glacial weathering become progressively pronounced, so that the recency of the ice uncovering is more and more marked.

O. H. Hershey has the first installment of a paper on 'Esker's indicating stages of glacial recession in the Kansan epoch in Northern Illinois.'

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 272D MEETING, SATURDAY, MARCH 27.

C. H. TOWNSEND spoke of 'The Distribution and Migration of the Northern Fur Seal,' giving a summary of the results obtained from a study of the log books of pelagic sealers, and illustrating his remarks by a chart showing the location of the seals on the Asiatic and American coasts at different seasons. The two herds, the American and the Asiatic, did not mingle, and the migrations of the former were much the more extensive of the two.

Charles Louis Pollard discussed 'What Constitutes a Type in Botany,' arguing in favor of recognizing multiple types when necessary. He suggested the abolition of the expression 'duplicate type,' on the ground that all specimens on which the original diagnosis is based must be of coordinate rank as actual types.

Lester F. Ward gave a 'Description of Seven Species of *Cycadeoidea* from the Iron Ore Deposits of Maryland,' saying that up to November 4, 1893, but a single species was known, based on four specimens collected by Philip Tyson before 1861. In 1893 Mr. Arthur Bibbins began work in the iron ore beds, under the auspices of the Woman's College of Baltimore, and up to the preset time he had procured no less than 59 specimens. These belonged to seven different species, but at present there was no reason to recognize more than the one genus *Cycadeoidea*.

F. A. LUCAS,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 260th meeting of the Society was held on March 2, 1897.

Dr. H. Carrington Bolton read a paper entitled 'The Language used in Talking to Domestic Animals.' He discussed the subject under the various animals controlled by man, dogs, horses, cattle, sheep, swine and poultry, and gave illustrations from nearly every country in Europe and every State in the Union. His essay, which elicited much discussion, will appear in full in the *American Anthropologist*.

The discussion was by Professor Lester F. Ward, W. H. Blodgett, P. B. Pierce, Dr. Frank Baker, Mr. Walter Hough, Dr. J. H. McCormick and others.

J. H. MCCORMICK,
General Secretary.

MEETING OF THE N. Y. SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE New York Section of the American Chemical Society held its regular meeting on March 5th.

The following papers were read:

'Note on the Volumetric Estimation of Lead,' by J. H. Wainwright.

'Electrolytic Production of Alkali Nitrites,' by Wm. M. Grosvenor.

'Method of Drying Sensitive Organic Substances,' by C. C. Parsons.

'Chemistry of the Sanitary Control of Milk Supplies,' by E. J. Lederle.

'Quantitative Separations by Sodium Nitrite,' by Gilette Wynkoop.

'On the Composition of Beet Sugar Ash,' by C. F. A. Meisel.

'Determination of Lead in Lead Ores,' by Richard K. Meade.

The meeting was well attended, and much interest was shown in the papers read.

DURAND WOODMAN,
Secretary.

THE GEOLOGICAL CLUB OF THE UNIVERSITY OF MINNESOTA, FEBRUARY 20, 1897.

MR. WARREN UPHAM read a paper entitled 'The Topography and Glacial Geology of the City of St. Paul.'

Attention was directed to the remarkable northeastward loop of the Mississippi river, here interrupting its general southeastward course. The rock formations beneath the drift have a horizontal stratification, being, in ascending order, the St. Peter sandstone, Trenton limestone and Trenton shales. The observed thickness of the shales is about 145 feet, their highest outcrop being 260 feet above the river or 945 feet above the sea. Above these bed rocks the glacial and modified drift deposits form the surface, and rise in morainic hills and smoother ridges from 200 to nearly 400 feet above the

river. The most noteworthy feature in the glacial geology of the area of St. Paul (comprising 55 square miles) consists in its deposits of modified drift at high levels, forming a group of plateaus of gravel and sand, rising with steep slopes to nearly flat upper plains 100 to 125 feet above the highest terraces representing the old flood plain of the river valley. These plateaus tell of a water level peculiar to this area; and the general contour of the region, the sigmoid course of the Mississippi, and two moraine belts, one of northeastern drift in the east part of the city, and another of northwestern drift in the west part, imply that this was the site of a glacial or ice-dammed lake, which is named *Lake Hamline*. The surface of the glacial lake during the early part of its existence, as shown by the Hamline and Como plateaus, was about 250 feet above the present river, or 930 to 940 feet above the present sea level. A little later, when the plateau a mile east of Lake Como was formed, the glacial lake level had fallen five or ten feet. Still later plateaus show that this lake finally was reduced to 875 or 870 feet above the sea. Its outlet was toward the southwest and south, across the present watershed between the Minnesota and Mississippi rivers, to Rich Valley and the Mississippi. The modified drift forming the plateaus has an aggregate volume of a tenth of a cubic mile, and it is thought to have been brought by streams from the englacial and finally superglacial drift of the waning ice sheet.

Charles P. Berkey,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

The regular monthly meeting of the Texas Academy of Science was held in the chemical lecture room of the University of Texas on Friday evening, March 5, 1897.

Papers were presented by Dr. E. F. Northrup, professor of physics, on 'Ether,' and by Dr. H. W. Harper, professor of chemistry, on 'A New Suggestion Concerning the Transmutation of Matter.'

Since the February meeting of the Academy the transactions for 1896 have been published, together with the proceedings, from its organization, January 9, 1892, to January 1, 1897, thus completing Volume I. This publication of 404 pages contains the constitution, lists of officers, patrons, fellows and members, thirty-four papers in full and seven abstracts. Of the papers and abstracts thirteen are upon geological or related subjects; six on mathematics; six on biological and allied topics; four on engineering; two on philosophy; two on education and culture; and one each on physics, language, ethnology and physiological chemistry; to these there must also be added four addresses of a somewhat general character.

As now constituted the Academy consists of two patrons, each of whom has paid into the treasury $500, thirty-four fellows and 107 members.

Frederic W. Simonds.

NEW BOOKS.

The Will to Believe. W. James. New York, London and Bombay, Longmanns, Green & Co. 1897. Pp. xvii+332.

An Introduction to Geology. William B. Scott. New York and London, The Macmillan Company. 1897. Pp. xxvii+573. $1.90.

Untersuchungen über den Bau der Cyanophycien und Bakterien. Alfred Fischer. Jena, Gastav Fischer. 1897. Mark 7.

Zur Zoogeographie der landbewohnenden Wirbellosen. Otto Stoll. Berlin, R. Friedländer & Sohn. 1897. Pp. 113. Mark 4.

Das Tierreich. I. Lieferung, Aves. bearbeitet von Ernst Hartert. Berlin, R. Friedländer und Sohn. 1887. Pp. 98. Subscription price, Mark 4.50.

First Principles of Natural Philosophy. A. E. Dolbear. Boston and London, Ginn & Co. 1897. Pp. 318.

Laboratory Practice for Beginners in Botany. W. A. Setchell. New York and London, The Macmillan Company. 1887. Pp. xiv+199. 90 cts.

La cause première d'après les données expérimentales. Émile Ferriere. Paris, Felix Alcan. Pp. 462.

The Phase Rule. Wilder D. Bancroft. Ithaca, N. Y., The Jour. Phys. Chem. 1897. Pp. viii+255.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, MARCH 26, 1897.

CONTENTS:

The Forest Reservation Policy: B. E. FERNOW....489

Experiments upon Metabolism in the Human Body, under the Direction of the United States Department of Agriculture....493

An Induction Coil Method for X-Rays: CHARLES L. NORTON, RALPH R. LAWRENCE....496

The New York State Science Teachers' Association (II.), including Addresses by Ralph S. Tarr and Richard E. Dodge: FRANKLIN W. BARROWS..498

Current Notes on Physiography:—
Tennessee Valley Region, Alabama; The Preglacial Kanawha Again; Stages of Appalachian Erosion; Baltzer on the Diluvial Aar Glacier: W. M. DAVIS....507

Current Notes on Meteorology:—
The Teaching of Climatology in Medical Schools: Sunstroke Weather of August, 1896; Deforestation and Rainfall: R. DEC. WARD....508

Current Notes on Anthropology:—
The European 'Quaternary' Man; The African Dwarfs: D. G. BRINTON....509

Scientific Notes and News:—
A Bill for the Suppression of Science, Literature and Art; General....510

University and Educational News....514

Discussion and Correspondence:—
The Former Extension of Ice in Greenland: R. S. TARR, T. C. CHAMBERLIN. *History of Elementary Mathematics:* FLORIAN CAJORI....515

Scientific Literature:—
Creighton's Microscopic Researches on the Formative Property of Glycogen: R. H. CHITTENDEN. *Barnes' Analytical Keys to the Genera and Species of North American Mosses:* GEO. F. ATKINSON..517

Scientific Journals:—
Journal of Geology: H. F. B. *American Chemical Journal:* J. ELLIOTT GILPIN. *The Astrophysical Journal*....519

Societies and Academies:—
Torrey Botanical Club: EDWARD S. BURGESS. *Science Club of the University of Wisconsin.* W. S. MARSHALL. *The Academy of Science of St. Louis:* WM. TRELEASE. *Science Club of Northwestern University:* THOMAS F. HOLGATE....523

New Books....524

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE FOREST RESERVATION POLICY.

ON March 3, 1891, the Congress of the United States enacted into law a new and important policy, namely, that the government should own and hold in perpetuity certain lands other than those needed for its immediate purposes or those set aside for parks.

This departure from the accepted policy of the past, according to which the public domain is held by the government only until it can be disposed of to actual settlers, was based upon the perception that a forest cover on slopes and mountains must be maintained to regulate the flow of streams, to prevent erosion and thereby to maintain favorable conditions in the plains below.

Enormous devastation of the public timber by theft and fire has gone on for decades, through absence of any care and through lack of any rational system in the manner of permitting the utilization of the wood material by the resident population. For the last 25 years every Secretary of the Interior, every Commissioner of the General Land Office, has pointed out this deplorable condition and has asked for legisla-

tive relief. Bill after bill has been introduced for the protection of the public timber, but most of these never found consideration even in the committees, much less on the floor of the two Houses of Congress.

HISTORY OF FOREST RESERVATIONS.

In 1887 the then Secretary of the American Forestry Association formulated and had introduced into the 50th Congress an elaborate bill (afterwards in modified form known as the 'Paddock Bill,' 52d Cong., Senate 3,235) providing for the withdrawal of all timber lands on the public domain from entry or other disposal, setting the same aside as public forest reservations, and instituting a fully organized service in the Department of the Interior to take care of such forest reserves, protecting them against fire and theft, regulating their occupancy by prospectors, miners and herders, and permitting the cutting and sale of the timber under a system of licenses and under application of rational forestry methods.

Of this radical yet reasonable legislation all that could be obtained was the enactment of a brief clause, inserted at the last hour of the 51st Congress into 'An Act to repeal Timber-culture laws and for other purposes.' The credit for securing this recognition belongs to the then Secretary of the Interior, Hon. John W. Noble. This clause, approved March, 1891 (Public—No. 162, Sec. 24), by which the important policy of forest reservations was established, reads as follows:

> That the President of the United States may from time to time set apart and reserve in any State or Territory having public land bearing forests, in any part of the public lands, wholly or in part covered with timber or undergrowth, whether of commercial value or not, as public reservations, and the President shall, by public proclamation, declare the establishment of such reservations and the limits thereof.

Under this law seventeen forest reservations were made, sixteen by President Harrison, largely at the end of his administration, and one by President Cleveland, on September 28, 1893. The estimated area of these is 17,500,000 acres. In some cases these were asked by petition and were investigated by the General Land Office; in others they were announced without previous public notice. In the absence of specific legislation the Secretaries of the Interior construed the reservation of these lands as a withdrawal not only from sale and entry, but from all use whatsoever, the Department being powerless to protect or utilize the same. *This was never the intention of the projectors of the forest reservations.*

As a result, strong opposition has grown up in the States where these large areas had been withdrawn from use. Although petitions for a number of other reservations had been prepared, the advocates of the reservation policy have not considered it wise to extend the reservations until the needed legislation could be had providing for their rational use and administration.

When it became apparent that the original bill (the Paddock bill), although most desirable was too elaborate to be considered by Congress, a short bill, leaving the detail of framing rules of occupancy and use to the Secretary of the Interior, was prepared. This has become known as the McRae Bill (53d and 54th Congress, H. R. 119), Hon. Thos. C. McRae, Chairman of the Committee on Public Lands of the 53d Congress, having with great interest forwarded the same. This bill, with amendments, was passed by the House of Representatives in December, 1895, and almost the same bill, with further amendments was passed by the Senate, but failed to become law. During the second session of the 54th Congress the McRae Bill (H. R. 119), again modified, was again passed by the House, but remained unreported from the Committee on Forest Reservation in the Senate, while a bill, essentially the

same, was reported from that committee but remained on the calender without action.

In the fall of 1895, finding that the arguments for legislation did not procure its enactment, the Secretary of the Interior was induced by the Executive Committee of the Forestry Asssciation to call upon the National Academy of Science for an expression of advice as to the need and methods of a proper administration of the public timber lands, in order to secure the weight of authority of that body to the proposition. The Academy, as customary, appointed a committee, asked an appropriation of $25,000 for the purpose of field examination, and members of this committee visited the regions where public timber lands are situated. As a result of this journey a report was made to Hon. D. R. Francis, Secretary of the Interior, advising the reservation of some 20,000,000 acres. On February 22d President Cleveland, following the suggestion of Mr. Francis, proclaimed the reservations asked for.

This sudden withdrawal from use of such a vast area, some of which was occupied by mining and lumbering industries dependent upon wood supplies, created strenuous opposition in the Senate and led to the adoption of a clause in the Sundry Civil Appropriation Bill at once restoring these reservations to the public domain. The House members of the Conference Committee, however, succeeded in substituting an amendment by which practically the main provisions of the McRae Bill were incorporated, namely, empowering the Secretary of the Interior to regulate their use and occupancy by miners, herders, etc., and for the sale of timber as needed under proper forestry regulations. This amendment failed of acceptance, except that part which empowers the President to restore all or parts of the reservations. The bill did not become a law, not being signed by the President.

REASONS FOR THE ESTABLISHMENT OF FOREST RESERVATIONS.

The forest and brush cover of the mountains in the country west of the 100th meridian occupies a small proportion of the total area, probably not more than 35 per cent. The timber of useful kinds occupies hardly 15 per cent. of the whole. The distribution and character of this growth is extremely variable, from the chapparal and stunted growth of southern California and the open pine, cedar and spruce of the lower Rocky Mountains to the magnificent world-famed giants of the Sierras and the dense unmatched forest growth of the Cascade and Coast Ranges in northern California, Oregon and Washington. Corresponding to the difference in distribution and development of forest growth, the climate, especially with reference to moisture conditions, varies. The northwestern portion of the Pacific coast has an abundance of rainfull and high relative humidity; the southern portions and lower Rocky Mountains are more or less arid. In either section a forest cover of the higher elevations and slopes is needful; in the one case to hold back the snow and rain waters from inundating agricultural lands below; in the other case to preserve the scanty water supply by impeding evaporation. In both cases the wood supply needs careful husbanding, for, in the absence of something better, even the poor material of the southern areas is needed for domestic uses. The magnificent timber of the Northwest, most wastefully lumbered and shipped away while the home consumption is limited, will ere long be needed at home and should be cut with due regard to the future and to reproduction.

The attempts of the goverment to protect its own property have been ineffectual and futile. The laws enacted in 1878 appear to make legal a systematic plundering of this property. Hundreds of square miles have been absolutely destroyed by un-

checked forest fires. Thousands of acres of valuable timber have been appropriated without any equivalent to the Treasury and without even an attempt at settlement as contemplated under the law. There are no provisions now on the statutes under which any citizen can obtain wood from the public domain by purchase, except that on the Pacific coast a man may buy 160 acres of it at $2.50 per acre for his own personl use only. A mining company needing timber must either steal, buy stolen timber, or obtain it by circumvention or perversion of the law—at least of its intention, if not its wording. Large mill establishments, able and willing to pay, are forced to cut logs on government land free of charge under a permit system, which was invented for the single settler, the pioneer, whose right to help himself to what he needed was thereby established. Hundreds and thousands of men have been induced to perjure themselves, in order that a lumbering company might acquire sufficient acreage from which to supply itself with timber.

Not only has this baneful legislation led to the destruction of millions of dollars worth of forest growth, but it has prevented any reasonable administration of the public timber domain, and has tended to lower the moral plane of otherwise estimable citizens with regard to their respect of public property.

"The community has become demoralized with reference to this question, for it is forced to steal one of the necessaries of life. The paramount and absolute necessity to obtain timber for use overrides all considerations. To the miner and settler the use of timber from local supplies is as absolutely necessary as the use of water and air, and no plan of management which fails to recognize this necessity can hope to be successful."

The proposed forest laws are designed to remedy this condition of antagonism between the population and the administration, which is vainly trying to enforce unreasonable laws. Reservation is the first step; regulation of the use of the timber the second; perpetuation of a valuable resource for coming generations the object.

The program of those urging this policy is as follows:

1. Withdraw from sale or entry all lands not fit or needed for agriculture, and constitute as objects of special care by the government the lands at the headwaters of streams and on mountain slopes in general.

2. Permit prospecting, mining and other occupation under such regulations as to prevent unnecessary waste, and cut and sell the timber under such methods as to secure perpetuation and renewal of the forest growth.

3. Provide for protection against fire, theft and unlawful occupancy.

4. Respect all existing vested rights, and arrange an exchange, if necessary, for private lands included in reservations; finally, restore to the public domain for entry all lands which are found within the reservations fit for agriculture.

5. The rational management of these forest areas for the benefit of the future as well as of the present and for all interested without destruction.

These are the business-like propositions embodied in the so-called Paddock Bill, and the same underlie the less elaborate McRae Bill, passed by the House of Representatives in the first session of last Congress, and also underlie the clause which the House tried to incorporate in the Sundry Civil Bill of the second session of the 54th Congress. The interests of the miner, the lumberman, the settler, of every citizen in the present and in the future, is to be taken care of in these forest reservations.

There is one industry, and one only, that finds no consideration in this policy. It is that of the sheep herder. Not that his

business is considered illegitimate as such, but, carried on as it has been, it is incompatible with all the other interests which the forest may subserve. Roaming through the woods, from township to township, from county to county, from State to State, the herds not only destroy the herbage and young trees and seedlings, but the irresponsible herder burns over the pasture, kills the underbrush and young growth that may have sprung up. This treatment, added to the trampling of the soil by the sharp hoofs of the sheep, finally changes the surface so that no seed can germinate, and natural reproduction is prevented and the forest is doomed to destruction. Just as the proverbial incompatibility of the goat and the garden, so the growing of wool and wood on the same gound is incompatible.

Some of the provisions of the bills as passed by the House do not meet the approval of the Executive Committee of the American Forestry Association; nevertheless the main principle underlying, namely, the recognition of the legal status of the forest-reservation policy and of the necessity of their rational management, make it desirable to have this legislation enacted, with the expectation of amending its faulty provisions later.

It is hoped that the 55th Congress will fully recognize the wisdom of upholding the forest reservation policy, and will enact the legislation necessary to make the reservations useful to the fullest extent.

B. F. FERNOW,
Chairman Executive Committee,
American Forestry Association.

EXPERIMENTS UPON METABOLISM IN THE HUMAN BODY, UNDER THE DIRECTION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

THE Department of Agriculture has received and is about to publish the details of the experiments on the nutrition of man, the brief reports of which have lately excited so much interest in different parts of the country. These experiments are carried out under the auspices of the Department of Agriculture, at Wesleyan University, in Connecticut, in cooperation with the Storrs' Experiment Station. They belong to a series of inquiries upon the economy of food and nutrition which are being prosecuted in cooperation with universities, college settlements and benevolent associations in different parts of the country. The special objects and methods of the experiments in Connecticut are referred to by Professor Atwater, special agent of the department in charge of nutrition investigations, as follows:

"Research upon nutrition has brought us to the point where the study of the application of the laws of the conservation of matter and of energy in the living organism are essential. For this purpose a respiration calorimeter is being devised. This is an apparatus in which an animal or a man may be placed for a number of hours or days, and the amounts and composition of the excreta, solid, liquid and gaseous; the amounts and composition of the food and drink and inhaled air; the potential energy of the materials taken into the body and given off from it; the quantity of heat radiated from the body, and the mechanical equivalent of the muscular work done, are all to be measured."

This apparatus includes a so-called respiration chamber. This is practically a box with copper lining. It is 7 feet long, 4 feet wide and 6½ feet high, large enough for a man to live in. It is provided with glass doors, through which the subject enters; and with a chair, table and cot bed. A current of air sufficient for ventilation passes through the box. Arrangements are made for passing in the food and drink and removing the excretory products. The food, drink and excretory products are all carefully weighed, measured and subjected to chemical analysis. The ventilating current of air is measured and analyzed. In this way it is possible to learn just what ma-

terials are taken into the body and what are removed from it. Arrangements are also made for regulating the temperature inside the chamber. In these experiments cold water is passed through tubes in the respiration chamber. These tubes act as absorbers, the heat given off from the body being taken up and carried away by the current of cold water. In this manner the temperature is kept at a point which is comfortable for the occupant at all times. This is the reverse of the system followed in heating houses by means of hot water passed through radiators from which the heat is given off into the rooms. A man can remain in the respiration chamber an indefinite time without particular inconvenience. The experiments thus far made have been of from 2½ to 12 days' duration. The assistant who remained in the chamber during the longest experiment experienced so little inconvenience that he is by no means unwilling to undertake the same task during a period of even longer duration. Observers are at hand day and night. They not only attend to the wants of the subject and supply him with food and drink, but also make the weighings, measurements and analyses needed for the experiment.

THE EXPERIMENTS AND THEIR RESULTS.

These can be best explained by first describing the diet and its nutritive ingredients and then referring to the effects of the food upon the body of the subject. Facts drawn from several of the experiments will be used for this purpose. The first experiment was made with a laboratory janitor. He was a Swede about thirty years old and weighed, without clothing, 148 pounds. He was accustomed to rather active muscular labor, and previous experiments had shown him to be a decidedly 'hearty' eater. He remained two and one-fourth days in the apparatus. He drank water *ad libitum*. His daily food was as follows:

	Ounces.
Cooked meat	4.3
Eggs	3.5
Potatoes	5.3
Bread	8.8
Milk crackers	3.5
Butter	1.1
Cheese	2.7
Milk	35.1
Sugar	0.8
Coffee	10.5
Total	75.6

During the experiment the subject did no work; he read a little, but had extremely little muscular exercise. The diet was necessarily simple because of the labor required for the preparation, measurement and analysis of the foods. It was, however, entirely agreeable to the subject and the quantities were such as he chose. In estimating the quantities of nutritive ingredients of the food it is customary to take into account the protein, fats and carbohydrates and the potential energy or fuel value. The protein compounds which occur, for example, in the lean of meat, white of egg, casein of milk, gluten of wheat, are the so-called tissue-forming substances. They make blood and muscle, bone and brain. The fats include the fat of meat, the fat of butter and milk, the oil of wheat, etc. The carbohydrates are the sugars and starches, such as the starch of bread and potatoes and ordinary sugar. The fuel values are estimated in heat units or calories. The fats and carbohydrates are the chief fuel ingredients of the body, although the protein compounds serve to some extent as fuel. But while the protein compounds can do the work of the fats and carbohydrates in supplying fuel for warmth for the body and for its muscular work, neither fats nor carbohydrates can take the place of the protein in building and repairing the tissues of the body. In considering the nutritive in-

gredients of the food, therefore, we have to take into account the amounts of protein and the fuel values. The daily diet used in this experiment was found to furnish, in digestible form, 4.8 ounces of protein and 2,960 calories of energy. It may be added that coffee, like tea, contains practically no nutrients, except those of the milk and sugar used with it.

Taking into account the food and excreta it is possible to calculate how much protein or fat the body gained or lost per day during the experiment. In the experiment with the diet referred to, the man's body gained about half an ounce of protein and two and one-tenth ounces of fat per day. This shows that the diet was more abundant than was required for the maintenance of his body. In other words, he was supplied with more protein and fuel ingredients than he required. This was not surprising, since during the period of the experiment he performed practically no muscular work, while his diet had been selected in accordance with his ordinary eating habits when he was engaged in his daily labor.

In a second experiment with the same man the diet was reduced, mainly by diminishing the amount of milk from about one quart to one pint per day. The protein was thus reduced to 3.9 ounces and the fuel value of the digested nutrients to 2,650 calories. With this diet the body almost exactly held its own as regards protein, but still gained a small quantity of fat, about half an ounce per day, showing that the food still exceeded the amount needed to supply the wants of the man's body when he was practically at rest. It was calculated that if the amounts of milk, potatoes and butter in his diet had been reduced by one-half the nutrients would have just sufficed to meet his needs under the conditions of the experiment.

In another experiment, which is the most interesting of all, the subject was a young man 23 years of age, rather taller than the laboratory janitor, quite muscular, and weighing 168 pounds without clothing. He had been accustomed for a number of years to school and college life, and later, to the work of an assistant in the college laboratory. This occupation involved but little muscular activity. Previous experiments had shown that he was inclined to eat rather small quantities of food. His daily diet during the experiment was of his own choosing as in the former case. The food materials were as follows:

	Ounces.
Cooked beef	3.4
Mashed potatoes	3.5
White bread	5.4
Brown bread	8.8
Oat meal	1.5
Beans	4.3
Butter	1.6
Milk	22.9
Sugar	0.6
Apples	4.3
Total	56.3

The experiment showed that he digested from this food on the average about 3.3 ounces of protein and with it enough fats and carbohydrates to make the fuel value of the digested food 2,500 calories per day.

The experiment was divided into five periods. During the first period (1½ days) and the fifth (1⅔ days) the subject was at rest. He passed more or less of the time in reading, but did nothing to require any considerable exercise of either muscle or brain. The second, third and fourth periods were of 3 days each. During the second period he engaged in severe mental work, partly in calculating the results of experiments and partly in studying a German treatise on physics. The third period was one of absolute rest. The subject sat in his chair or reclined upon the cot bed, but did no reading and moved about as little as possible. In the fourth period he per-

formed severe muscular exercise. During eight hours of each of the 3 days he was engaged in raising and lowering a heavy weight which was suspended by a cord passing over a pulley at the top of the chamber. The work in this case was so severe that he was thoroughly exhausted.

The result showed that the subject during the periods of rest gained about half an ounce of protein and lost not far from the same quantity of fat daily. The diet which was roughly calculated in advance to be very nearly sufficient for the needs of the organism when no considerable amount of work was done proved to have a slight excess of protein and not quite enough fats and carbohydrates. With the severe mental work the results were almost exactly the same. During the 3 days of hard study the organism consumed about the same quantities of nutrients as when it was at rest. Whether this would prove true for a longer period is not certain.

During the period of hard muscular work the results were quite different. As was to be expected, the food did not suffice for the demands of the body. Instead of gaining one-half an ounce, the organism lost about one-sixth of an ounce of protein per day, while the loss of fat reached 6.9 ounces. The fuel value of the materials consumed in the body during the periods of rest and of mental work ranged from 2,600 to 2,700 calories per day, but in the period of muscular work it rose to 4,325 calories. In this case, therefore, the severe muscular work increased the consumption of protein by over half an ounce and the consumption of fats by more than seven ounces per day. The experimenters have estimated the changes which would have been needed in the daily food to make it equal to the demands of the body during the period of muscular work. They calculate, for instance, that if the daily food had been increased by doubling the butter and sugar and adding half a pound of bacon it would have been sufficient.

The chief interest of these experiments, from the practical standpoint is the light they throw upon the ways the food is used in the body and the kinds and amounts that are appropriate for people of different occupations and under different circumstances. Physicians tell us that disease is largely due to errors in diet. It is only by such researches that the exact knowledge can be acquired which is needed to show how our diet can be fitted to the demands of health and strength as well as purse. In addition, the experiments have great scientific interest.

A number of experiments of this kind have been made in Europe, but these are the first in the United States. These investigations are being continued by the Department of Agriculture, and further reports may be expected from time to time.

Thus far we have described only those features of these investigations which included the measurement of the income and outgo of matter and the determination of the fuel value of the food. The fuel value of excretory products was also determined, as well as the energy manifested by the body in the form of heat or external muscular work. For the measurement of the body's energy delicate and elaborate apparatus was devised. Highly interesting results have already been obtained, but so many improvements in the methods and apparatus have suggested themselves during the progress of the work that it has not been deemed advisable to publish the details of this part of the investigation at present.

AN INDUCTION-COIL METHOD FOR X-RAYS.

SINCE sending a note of a new method of operating an induction coil by the discharge of a condenser we have used it for operating X-ray tubes, and find it gives us a

much more powerful means of driving than any method we had heretofore tried. An exposure of one second gives an excellent negative of such common test objects as coins in a purse, and an exposure of five seconds is sufficient to give a negative showing clearly all the bony structure of the hand and wrist, a negative sufficient for the purposes of a surgeon. The best negative of the hand is to be obtained in about 20 seconds, and 45 seconds gives a marked over-exposure. Not only the bones, but the outlines of the cartilaginous and fatty tissues, and the tendons, are shown in a negative from a 25-seconds exposure. We have not had any opportunity to take any photographs through the body, but judging from results given by the flourscope this method gives a far greater penetration of the rays and a much sharper outline of the shadows than any other we have used. The fluorescence is absolutely steady; the pulsations of the heart can be seen with startling clearness, and the outline of the liver and lungs may be sharply distinguished. The details of the bony structure of the trunk are also clearly shown. The ribs appear as tubes rather than solid rods, owing perhaps to the outer portion being more dense than the inner. The processes on the spinal column are well marked. The hand of the observer may be held between the patient under examination and the tube, and a clear image of its bones may be seen even through the most dense portions of the trunk.

The tunstate of calcium crystals glow so brightly as to make the screen have a distinctly granular appearance. Each crystal seems to be separately illuminated like the grains of sand on a piece of coarse sand paper placed in the bright sunlight.

The effect of prolonged running on the tubes is very similar to that of a static machine, only more pronounced. The resistance of a tube may be increased by running with closed spark-gap, making the concave electrode cathode as usual. If the tube be reversed the resistance will be lowered. It is very often found that a tube which has been run hard for some time when allowed to cool will increase in resistance, so as to be beyond the range of the coil. By running such a tube, making the concave electrode anode on the coil a few minutes, the resistance will be lowered. Slight warming will facilitate matters. Again reversing the tube and running with closed spark-gap, the tube may be brought back to its maximum efficiency in a very few minutes. We have repeated this operation five or six times on some of our tubes with good results. It is needless to say that the above applies only to focus tubes with a platinum anode.

The part played by the spark-gap is not yet clear to us, but we have noted the following observations: A spark-gap between spheres is better than one between points. Some tubes will run without a spark-gap, but when the gap is used it should be on the cathode end of the tube. The proper adjustment of a spark-gap may increase the intensity of radiation several hundred per cent.

The platinum anode in the focus tubes which we use becomes red hot, and the whole tube feels warm to the hand. This is true of tubes which do not heat when driven by a 12-plate, 26-inch Wimshurst machine.

As stated in our note of February 17th, we are operating our induction coil by discharging through its primary a condenser which has previously been charged at 220 volts from the lighting mains. This charging and discharging we now accomplish 250 times a second by means of a five-part commutator on the shaft of a small motor. Since the condenser is disconnected from the mains only when it has risen to their voltage, there is no spark ing when it is disconnected; and since

the discharge of the condenser is exceedingly rapid, it has entirely passed before the commutator segment has left the brush leading to the primary. In other words, the condenser brush leaves its commutator segment when both are at 220 volts, and the coil brush leaves its commutator segment when both are at zero. Hence no sparking need occur on the commutator except the slight spark of making circuit.

The great increase in voltage at the terminals of the secondary over that given by the same coil when operated in the ordinary manner is probably due to the exceeding rapidity of discharge of the condenser, and hence the rapid change in the number of lines of force enclosed by the secondary. For each discharge of the condenser there must be a rise and fall of the current in the primary of the induction coil; but, since we get a uni-direction discharge at the secondary, one of these alone, either the rise or fall, must be effective. The reaction of the secondary of the coil tends to increase the rapidity of rise of current in the primary, but tends to retard the fall, moreover, at the instant the condenser is connected to the coil we have 220 v., the potential of the condenser, applied to a circuit of exceedingly low resistance and very small induction, and from this we must get an extremely rapid rise of current. From these considerations alone it appears probable that the secondary discharge is due to rise rather than to the fall of current in the primary.

The volume of the discharge is so great that the ends of the secondary bristle with brush discharges, even when the terminals are within sparking distance of one another, and great care must be taken in insulating the primary from the secondary. There seems, moreover, to be a continual brush discharge from turn to turn of the primary, the nature of which we are unable to determine. If the iron wire of the core be put in a glass tube, and the primary be wound in a single layer about it, and the whole inclosed in a second larger tube, and the space between the tubes be filled with oil, the needed insulation is given.

Charles L. Norton,
Ralph R. Lawrence.

Rogers Laboratory of Physics,
Massachusetts Institute of Technology,
Boston, March 5, 1897.

NEW YORK STATE SCIENCE TEACHERS' ASSOCIATION, II.

[*Continued from p. 468.*]

Wednesday evening was devoted to the Earth Sciences. Dr. Frank M. McMurry, of the Buffalo School of Pedagogy, read the following paper, written by Professor Ralph S. Tarr, of Cornell.

Place of the Earth Sciences in the Secondary Schools.

The question is raised again and again, shall the earth sciences (geology and physical geography with their subdivisions) have a place in the curriculum of the secondary school? and this has been variously answered. Many schools have properly omitted them from the course, and others are thinking of doing so. I say properly, because, as the subjects have been taught in the majority of cases, it is better to omit than to continue them.

Then again, when the question is under consideration, which of the natural sciences shall have a place in the schools, we very often find the earth sciences excluded, though this was certainly not the case in the report of the Committee of Ten. The reasons given for the exclusion of these subjects from the proposed curriculum are usually two: first, that they are not disciplinary subjects; and second, that for their proper understanding they need too much knowledge of other sciences. The first grows out of a failure to appreciate that there has been progress in the methods of teaching the earth sciences, a progress

which the critics have evidently not yet learned about, but which nevertheless has been most marked and important. The second conclusion of the critics is based in part upon this misunderstanding, and in part upon the misinterpretation of the possibilities embraced within the earth sciences. There is no subject of natural science which, for study of an advanced character, does not require a knowledge beyond the present ability of the secondary schools to give. We do not find it necessary to omit these sciences for this reason, but merely the part that presents the difficulty. Why does not the same principle apply to the earth sciences? Even when this exclusion of parts has been made, there is enough left.

It is my belief that no science is better adapted for the beginning in science study in the secondary schools than physical geography. There are two reasons for this belief. In the first place, of all the criticisms made against the science instruction in the schools, the one that appeals most strongly to my mind is that there is too much smattering and jumping about from one thing to another, before any real knowledge of any science has been gained. There is an effort to obtain wide information on various topics, with the result that almost no training is gained, and so much information is poured in that the mind of the student is necessarily confused. Physical geography is a direct extension of the geography study which has been carried on for years before in the lower grades. With this geography properly taught, and physical geography made an advanced continuation of this, there is at least one year added to the consecutive study of what may be properly considered closely allied subjects belonging to the same group.

The second reason for considering physical geography adapted, above all the other natural sciences, to first year study is that, when properly handled, it arouses a general interest which no other science does so well. That this point is correct I have long known, but never before have I so fully realized it as when, a few weeks ago, I visited a number of the Chicago high schools, where physical geography is being taught in the modern way. The eager interest, the evidence of acute observation and clear thinking, and the intelligent questions asked by boys in knickerbockers and girls just fresh from the grammar school, was the best proof I have ever seen of the truth of this conclusion. The teachers, forty in number, assured me in conference that no other subject aroused so much interest as that of physical geography, and this came from teachers most of whom were especially interested either in biology or physics.

This fact of interest I make a central point of the argument, because it is the means for obtaining an end. The old instruction in physical geography has for its object the imparting of information. The new school endeavors to make it a subject of disciplinary value. Observation is encouraged and, in fact, insisted upon. The results of these observations and of other groups of facts are placed together to make explanations. Weak arguments are tested and overthrown; fallacies are discovered and pointed out, and the subject is hence made to train habits of the mind which every high school pupil will need, if he lives by even a partial use of his mental powers. We need to know how to use and discover facts, and then to understand what they mean. The proper study of physical geography helps to train these habits of mind. No better means for gaining such a discipline can be found than to arouse the interest of the pupils. With interest, or, better still, with enthusiasm, the pupil observes and thinks beyond the requirements of the study and plies his teacher with questions, sometimes of great ingenuity.

Incidentally, however, he gains information; and I believe that much more of this is obtained by this means, and that this is much more firmly rooted in the mind than is the case when the main idea is the accumulation of the mere information which anyone can get from an encyclopedia or a dictionary.

If we are willing to grant that the earth sciences have a claim for a place in the secondary schools equal to that of the biological and physical groups, the question arises, how shall they be taught? This is, of course, a question which cannot be answered in a few words. We are confronted at once with the difficulty that the ideal at present seems impracticable. Nevertheless, I am going to dwell especially upon the ideal, believing that if this is set, and an effort is made to reach it, more progress will be made than if we are content to be held down to what seems to be practicable.

This matter is treated mainly from the standpoint of the colleges, though not without recognizing the fact that but a small number of the high school pupils enter the college; but in the belief that what is desired by the college is also best for the boy whose systematic education ends in the high school; and also because it seems that the college, by setting the standard, can mould and lead public opinion even in a new direction, provided, of course, there is also hearty sympathy and support from the teachers in the schools. If between us we can decide upon something, we can in time carry our point; but if we act independently, and along different lines, progress will be slow, indeed.

I am certain that I voice the sentiment of most of the college scientific teachers who have thought upon the subject when I say that the prime need in education today is some change in the college-entrance subjects which have so long served as standards. The world has been progressing, and even the college, one of the slowest of institutions to depart from tradition and precedent, is beginning to take cognizance of this. Natural science instruction is demanded by the people who support the schools, and so far the colleges have retarded the proper fulfillment of this demand, by so occupying the time of the student with other subjects, that natural science has been possible only in very small doses. The attempt has been made to supply the demand for information, but in most cases there has been but little more.

The science teacher of the college also needs and asks for more adequate science in the secondary schools. For my own part I am obliged every year to teach college students the simplest habits of observation, which might better have been learned in the kindergarten. To turn a boy out into the world trained in Latin, Greek and mathematics, and yet unable to use his own eyes or think with his own brain, is not treating him fairly. He is very poorly prepared to compete with the keen, shrewd intellect of some business man whose boyhood days were spent not in school, but in gaining a mental training from nature on a farm, or from men in that great, heartless school of affairs. To me it seems that the parents are demanding a knowledge of science; the pupil, whatever his chosen vocation, needs the training, and the college science teacher needs to have his students come to him with a better preliminary training.

Really valuable discipline in science, properly comparable to that gained from the classics or mathematics, cannot be obtained from courses of fourteen weeks each. Nor can it even be gained by courses of a year each. This is one of the points that prevents the science teacher of the college from making progress in his efforts to introduce science into the list of college-entrance requirements. He is immediately con-

fronted by the query whether the science instruction is really comparable with that of the stock entrance subjects; and he is forced to admit that it is not.

The reason why he must make this admission, which is fatal to his efforts, are first, that time enough is not given to any one subject or group, and that the method of teaching is generally not equally good. To be really comparable with Latin in disciplinary value, some one of the sciences, or group of allied sciences, should be taught consecutively for at least two or three years by means of laboratory methods, which call for expensive apparatus.

This is the ideal, but there are practical difficulties. The parents call for more than one science, and the committeemen are not willing to furnish the money for the necessary equipment. I have considered these difficulties elsewhere, and proposed a plan of compromise,* which is briefly to have *all* sciences represented in the course, but to have some *one* taught as a major subject, according to the best methods, and as a consecutive study covering not less than two years. Ultimately, when the benefits of a proper study of one science are shown, the school may see its way clear to the introduction of similar study of others; but I believe that one science properly taught is better by far than several poorly handled, as, of necessity, so often happens at present.† Which group is chosen seems to me of little importance.

I feel certain that the larger colleges of the country will stand ready to accept a properly taught science as an entrance alternative fully equivalent to advanced Latin, Greek or mathematics. There is no reason why it should not be considered an equivalent; and if the colleges can be assured that proper teaching and discipline is possible in the schools, the move can certainly be made. However, having set what seems to me the ideal, I must say that I think we shall find it necessary to start far short of it, though always moving toward it. One cannot change radically and suddenly; there are many questions to be considered, not all of which are familiar to the college teacher. Hence I believe it will be necessary to adopt a compromise course, with the distinct understanding that we are moving toward the higher end. Let us have four years of science taught as nearly as possible by laboratory methods. It would not be necessary for all students to take four years, but insist upon *everyone* having not less than one year of genuine science instruction. For those who, by choice, take a course which allows of consecutive study for four years it would, perhaps, be better to have this kept along the line of some allied subjects; but, as this is hardly possible, the instruction should be confined within as narrow limits of subject-matter as possible.

Because of the interest which it arouses in science subjects, and the training which it furnishes to the important powers of observation and reasoning, physical geography is the best adapted of the sciences for the basal study. Moreover, numerous experiments have proved that it fits admirably into the first-year curriculum. It would be well if this could be supplemented and continued during the second year by a study of geology, which is so closely allied to it; but, perhaps, in most cases the demand for instruction in the biological and physical sciences will be so great that this will not be possible.

*Educational Review.

†I have recently had an application for a teacher of physical geography; and when it become known, a number of students have come to me; one of them, a former teacher, when I said that a real knowledge of physical geography was needed, replied, that she had taught nearly everything, and could do so in the future, and that she would be ashamed of herself if she could not teach so simple a subject as physical geography.

If the schools will offer genuine science instruction the colleges will no doubt accept it, and thus lend encouragement to the schools in their effort to give such instruction. Why should not a minimum science *entrance requirement* be set by the college, leaving the subject elective, but demanding that every student on entrance shall have had at least one year of *genuine disciplinary* science instruction; then, as one of the alternative requirements, allow the acceptance of advanced science study in the place, let us say of Greek or advanced mathematics, etc. Four years of properly conducted science study gives as valuable a training and culture, even though this be of a somewhat different kind, as an equal time spent in the study of German, Latin or mathematics. The colleges which permit election of studies are practically committed to the theory that each subject well taught in the college is as valuable as any other.

The science instruction, both in the elementary and the advanced study, must be of the best if it would meet this requirement, and the teacher must know and have an interest in the subject which he teaches. No one can have an adequate knowledge of all the natural sciences, and it is unfair to ask a teacher to give instruction in them all. As time goes on this will be remedied, provided we can inaugurate a movement to improve science instruction; for such an improvement all along the line means, of necessity, more teachers. Therefore, it seems well for the present that the science teacher should be selected with special reference to his ability to give good instruction in *one* subject; and this he should be allowed to develop, as far as he can, with the constant effort to obtain higher grade work in at least one line of natural science. Well trained in one subject he will be a better teacher of the others than if he was equally well prepared in all sciences.

Very little has been said of physical geography, because it has seemed to me that there is a more important point pertaining to all sciences. I feel that it matters little whether the science instruction be in physical geography, physics, chemistry or biology, so long as it is genuine science instruction. That physical geography has a claim equal to the others can be demonstrated. To teach it in such a way that I would be willing to accept it as a subject for entrance to Cornell University there must be very much more than book work. The attempt to gain information must be subordinated to the effort to train the powers of observation, the habit of inquiry and ability to reason out valid conclusions from an assemblage of facts.

This training must in large part be gained by practice in the laboratory and in the field. The air, earth and water, the natural laboratories of physical geography, are accessible to all. They have lessons to teach, and furnish means for discipline of the nature suggested. The natural laboratory is not always accessible, nor are all features of physical geography capable of illustration in every instance. Hence, out-of-door work must be very decidedly supplemented by work within doors. We cannot, for instance, take many classes to a glacier. Models, maps, photographs and lantern slides must take the place of some features of the actual land. These are not so good as the real out-of-door examples, but, skillfully handled, they illustrate the facts well, and serve well as a means of gaining important training. In geology the same means may be used and these may be supplemented by the study of specimens of various kinds. Much material for this instruction is accessible and cheap, and schools that would make the study of physiographic subjects of disciplinary value must equip a laboratory with these materials. It is now no more possible to teach physical geography properly by means

of mere recitations than it is to give desirable instruction in chemistry or physics in this old-fashioned way.

The entrance examination in physical geography should then not be merely a set of questions upon the subject matter of a book, but also questions concerning the physical features of the neighborhood, and others which should prove the ability of the student to observe and to think. This should be supplemented by a note-book containing the record of the laboratory work actually done.

This is a statement of my conception of the results which we are to aim to obtain. How we shall reach the desired end is quite another matter, and one which certainly cannot be considered here. If we can become agreed concerning the goal, the means of approaching it, or even reaching it, will be found. I believe that we should first of all lay down a wise plan, and then try to follow it. A committee should be appointed to consider various suggestions and decide upon the best; then bring it before the society. After the plan is finally decided upon, the concentrated effort of our members will make it a success, provided it is a wise plan.

I have, therefore, spoken rather concerning the principle at large than concerning the particular claims of physical geography, or the means by which instruction in this can be given. The subject has claims which in any wisely made plan of procedure must be recognized. If it seems necessary to go over these claims it can be done. The subject offers a means of furnishing valuable discipline. Already enough has been written upon this subject to serve as a basis to guide the teachers along the proper line of advance in the mode of instruction in physical geography.

Discussion—The Earth Sciences. By RICHARD E. DODGE.

The Earth Sciences, including meteorology, geology and physiography, should most emphatically have a prominent place in the curriculum of the secondary and grade schools, for many reasons. They are capable of arousing the best mental faculties; they train observation and reasoning; they bring the child more closely in contact and sympathy with the world about him than do any other group of sciences. Once love for nature is aroused, the stimulation for deeper study follows without fail.

In the study of this group of sciences, as well as in all other sciences, the training should be largely by the laboratory method, and the laboratory should be out of doors as far as possible. In the progress of the work, the study of facts and the representations of facts should be augmented by a series of developmental exercises designed to lead up to and develop principles.

The method to be employed depends largely upon the personality and ability of the teacher, and no one method can be prescribed as a sure panacea for all ills of science teaching. Each teacher must aim to bring out scientific principles by some method demanding reasoning on the part of the pupil and causing advance from the simple to the complex. My experience has shown that such aims can well be accomplished if the facts be given by making the pupil solve a progressive series of related problems, each problem being solved through a similar series of related questions. The advance is thus by steps toward the end sought, each step being secured by a focalization of ideas toward the point in mind. Such a method of presentation is rational and scientific and is as capable of application in the grades as in the higher schools.

The simpler facts and principles should be crowded back from the high into the lower schools, and we cannot better the work in the higher schools until we have made the proper beginnings in sciences in

early youth. In such introductory work, we should aim for intensive and not extensive work, to give the ability to gain further information rather than mere knowledge of unrelated and incomplete facts, as is so often done.

Considering these as our aims, what should we aim to give for subject matter in each of the sciences under consideration?

In meteorology we should aim to give an understanding of the winds, precipitation, insolation, weather, climate, etc., and the dependence of life on climatic conditions. This work should be by the laboratory method, making use of the ever-present weather conditions and of maps, charts, weather maps and instruments of measurement.

In geology we should devote most attention to observational study of dynamical geology. Minerals, rocks and fossils should be studied only so far as they give a better understanding of the fundamental characters of the rocks themselves, except in those localities where there are fossiliferous rocks, where, of course, more stress can be laid on those subjects. The life processes of the earth and their results are the most rational, interesting and helpful features of geology to the beginner. In this science, as in any other, if function be made the causal condition and form the result, we have a rational arrangement of subject, and we at once elicit the confidence and sympathy of the pupil. The inorganic becomes alive and the dead sciences are no longer dead, but equally alive with the organic sciences.

In physiography earth forms should be studied, their origin, their relations and the dependence of life upon them. This is a broad and ever broadening field, and in it we can come more closely in contact with the world about us than in any other sciences. The application of the principles to the understanding of human history and progress offers a possible field of study that is almost inexhaustible and inspiring to the highest degree. Descriptive, political and commercial geography gains its greatest value when some understanding of the climatic and topographic determining conditions has been gained previously. Descriptive geography with no knowledge of the origin of land forms is like anatomy with no knowledge of the skeleton, which is the basis of anatomy. In this study a mere study of geographic distributions is not enough. The study should largely be one of comparison and of relation.

The science—for physiography is a science—thus becomes not only of value for itself, but also because of the light it casts upon the study of other subjects in the curriculum.

Such are some of the possibilities of the earth sciences if they be studied in a common-sense way. We must acknowledge that at present most teachers are not prepared to treat these sciences, so commonly called easy, in a scientific and broad way. One of our tasks is to see what can be done to give the secondary school and grade school teachers a better ability to teach the earth sciences with a scientific understanding.

Professor Albert P. Brigham, of Colgate University, emphasized the lack of training in observation on the part of students coming to the earth sciences in the upper years of the college course. This is more to be regretted since the subject is capable of graded presentation in all stages of education. Interest is absolutely to be depended upon in children or adults when earth facts are explained in a rational and simple manner. It is a grave loss if that great company who never go above the grades must go out ignorant of the common facts of out-of-door nature and of the earth materials upon which our daily life is dependent. Let us insist that geography is a

genetic science, vital, causal, evolutionary. Nor may we neglect the moral and æsthetic value of these studies. This is the work of the teacher who knows, who has a horizon, who can arouse and inspire.

Professor Charles S. Prosser, of Union, advocated the thorough teaching of geography in the grammar schools, suggesting the use of such a work as Frye's which should be followed in the high school by physical geography. The class-room work should be supplemented by excursions to localities in the neighborhood affording illustrations of some of the features of physiography.

It is now found that a portion of the college students when taken on geological field trips are indifferent to the illustrations of geologic structure. The early interest of boys in objects to be found in field and forest seems to have become atrophied, a condition of mind said by Professor Shaler to be due to super-civilization. This is more apparent in the students coming from large cities than in those from the smaller cities and villages. It was stated by the great teacher of geology—Professor Dana—that as a rule the students who mastered geology were those who had spent a considerable portion of their boyhood in the country. It was emphasized that this power to observe would be greatly developed by a high-school course, using such a work as Tarr's Elementary Physical Geography.

Professor E. C. Quereau, of Syracuse University, spoke on the need of correlation of the university and the secondary school work in physical geography. The geography taught in the lower schools has been too much descriptive and locative, the pupil being required to memorize geographical features, while the work which has been taken up in the college and university in later years has been a study of the origin and progressive changes of the surface features of the earth and their vital relations to the needs of man. A better correlation of the work, from the secondary school up to the college, would be an advantage.

Dr. Frank McMurry, of Buffalo, argued that mental discipline is not the highest aim in the study of the earth sciences in the high school curriculum. The great object to be emphasized in teaching literature, history, and nature study in the common school is inspiration. They arouse the whole mind, develop life-long tastes or loves, and hence become permanent sources of energy and mental life. The ability to arouse a great love for nature is the greatest object in bringing physical geography into the curriculum. It is a much nobler, higher purpose than discipline or information. This study can excite this love, because in it inductive work can be done; it can be concrete, and the laws involved can be reached through abundant data. Then, too, these data stand related in a causal way; they can fall into a causal series, a series in which function can take the lead and be more prominent than form. Further than that, as said by Professor Dodge, the whole subject can be approached through *problems*, and one series of problems can lead to another and higher series.

It is plain, then, that this is a science in which the subject matter is so arranged that it can be a source of great mental life; that is why this subject is so valuable. Life is controlled by loves, by tastes, and this subject is able to generate a great love for one field of nature.

Careful consideration of this science and proper teaching of it will ultimately influence greatly the teaching of geography in the grades. If we can once establish the conviction that the earth is alive and changing and active it can affect the teacher's attitude toward the grade work. Possibly at last physical geography can precede the book work in geography. This,

then, is also a reason for urging the importance of the earth sciences as a proper high school study.

Professor I. P. Bishop, of the Buffalo Normal, spoke of the importance of geology in the teaching of geography. Whether it be included in the school course or not, there is no doubt that it should form an essential part of the geography teacher's outfit. For it is manifestly impossible to teach the detached facts of physical geography so as to give them much educational value without knowing the causal relations upon which the significance of these facts depends.

It is not so difficult to obtain material for this kind of nature work as is often imagined; the true way is to study the material nearest at hand. Every gravel bank is a museum. Every stream, even to the tiny rivulet formed by a shower, illustrates the carving of a river valley or a Niagara gorge. In almost any village we can show how a hard layer of rock in the bed of a stream has made a waterfall, cascade, or rapid; how by the aid of a dam this has been utilized to run a saw or grist mill; how this has then naturally become a favorable spot in time for the location of a store, blacksmith shop, hotel, churches, schools, and the other interests of such a community. Thus the material available almost anywhere serves to illustrate the mutual relation between a country and its people.

Professor R. G. Wilder, of Cornell, recalled with dissatisfaction the time and energy expended by him during his earlier school days in the memorizing of many geographic names of comparatively insignificant localities, and held that in a natural order physical geography should precede rather than follow the ordinary political geography. He also believed that if, between 1860 and 1870, the study of physical geography had been carried even as far as at present, so that the public, and especially the clergy, could have realized that the apparently stable earth is really a sort of cosmic organism still in process of development, the acceptance of evolution might have required only a decade instead of the quarter of a century.

The discussion turned upon the best means of conducting excursions for the study of the earth sciences. It was admitted that in most schools too little attention is paid to this phase of the work. Teachers are too apt to strive for an interest in far-away matters, glaciers, trade winds and ocean currents, while they neglect the means that are nearest at hand for arousing and developing an interest in the earth. At the same time there were many expressions of warm appreciation of the work in some of our secondary schools, and in the grades as well. Reference was also made to the great assistance rendered by the American Museum of Natural History in its distribution of lantern slides to the schools of the State.

Mr. William F. Langworthy, of Colgate Academy, speaking of the teachers of geography in our grammar schools, said that their failure to accomplish better results in the direction of modern methods is not so much their own fault as the fault of those who have trained them, of those who have charge of our courses of study. Much time is lost in the lower grades upon some parts of arithmetic. If some of the more advanced portions of arithmetic were taken up in the later years of the high school course, or in college, it would leave more time for geography in the grades; but it is not advisable to crowd any more work into the grammar school course. It is better to enrich the grammar school course than to enlarge it.

The other speakers were Dr. D. L. Bardwell, of the Cortland Normal; Professor H. J. Schmitz, of the Geneseo Normal; Dr. T. B.

Stowell, of the Potsdam Normal; Professor William Hallock, of Columbia; Professor C. C. Wilcox, of Starkey Seminary; Professor Henry L. Griffis, of the New Paltz Normal; Miss Sherman, of Ithaca High School; Professor E. R. Whitney, of Binghamton; Mr. Charles N. Cobb, of the Regents' Office; Principal S. G. Harris, of Baldwinsville; Dr. Charles W. Hargitt, of Syracuse University; Mrs. S. H. Gage, of Ithaca; Professor Warren Mann, of Potsdam Normal; Principal Henry Pease, of Medina; Professor O. D. Clark, of the Boys' High School, Brooklyn, and Principal Henry S. Purdy, of Brewster.

FRANKLIN W. BARROWS.
BUFFALO, N. Y. *Secretary.*

(*To be Concluded.*)

CURRENT NOTES ON PHYSIOGRAPHY.

TENNESSEE VALLEY REGION, ALA.

A RECENT report for the Geological Survey of Alabama by Henry McCalley, on 'the Tennessee valley region,' contains a general description of the paleozoic area in the northern part of the State, excepting the Coosa valley district, which is reserved for a later volume. Account is given of the level sandstone uplands, or 'barrens,' in the northwest corner of the State; and of the rolling limestone lowlands with rich red soil in the valley of the Tennessee river; these two districts being the higher and lower parts of the dissected uplands which enter from Tennessee. Next to the east rise the table mountains of the dissected Cumberland (Allegheny) plateau. The waters of the tables often disappear in sinks, and reappear in large springs at the head of coves on the flanks of the 'mountains.' South of the Tennessee, Little and Sand mountains are monoclines or cuestas, with steep and ragged escarpments to the north and gentle slopes to the south. The broad flat 'Moulton and Russellville' valley lies between them, trending east and west. The Sequatchee valley of Tennessee is called Brown Valley in Alabama, and limits the preceding divisions on the east; it is excavated on an unsymmetrical anticline. An outline map locating these areas would have added much to the ease of interpreting the text. Most of the report is concerned with stratigraphic and economic geology; the illustrations are chiefly of quarries.

THE PREGLACIAL KANAWHA AGAIN.

REFERENCE should have been made, in a recent note on the Preglacial Kanawha, to the studies of Professor W. G. Tight, of Granville, Ohio, and of Professor I. C. White, of Morgantown, W. Va., regarding the changes in river courses of Pennsylvania and Ohio on account of obstructions by ice and drift. An article by the last named writer (Origin of the high terrace deposits of the Monongahela river, Amer. Geol., XVIII., 1896, 368–379) should have been cited, along with the note regarding Leverett's work from the Report of the Director of the United States Geological Survey; for both are concerned with identical problems. White describes several channels among the hills of the Allegheny plateau, where the waters of the impounded Monongahela for a time ran over cols; one of these channels being permanently adopted in the present course of the Ohio. When this region is mapped and studied in detail it promises to reveal features of peculiar interest in connection with the rearrangements of river courses by glacial action.

STAGES OF APPALACHIAN EROSION.

ALTHOUGH this series of notes cannot pretend to completeness, it has been the writer's intention to report here on all the more important American essays, and on certain foreign essays that are relevant to modern physiography. It was entirely by oversight that an abstract of Keith's brief

article on 'Some stages of Appalachian erosion' (Bull. Geol. Soc. Amer., VII., 1896, 519–525) was omitted from earlier notice. A tardy note upon it is therefore now presented. Keith contends against the conclusion of Hayes and Campbell regarding the warping of the Cretaceous and Tertiary Appalachian peneplains; he maintains that river basins at different distances from the sea must, in similar rocks and at similar stages of denudation, produce peneplains of different altitudes and of different inclinations; and that part of the inequality of altitude and attitude that was explained by the earlier authors as a result of warping is better explained as a result of difference of distance to the sea. The slopes of a number of peneplains, thus interpreted, is generally so slight that their present altitude is better accounted for by nearly uniform uplift than by pronounced warping. A fuller discussion of the problem is promised. We may then see it illustrated and argued with the detail that so important a matter deserves.

It may be noted that in New England a tilting of the Cretaceous peneplain of the uplands from its former lower and nearly level attitude is well proved; for the submature rivers of to-day run to the sea on flatter grades than the descent of the uplands; and this would be impossible if the peneplain had not been distinctly tilted.

BALTZER ON THE DILUVIAL AAR GLACIER.

THE thirteenth number of the Beiträge zur Geologischen Karte der Schweiz is a treatise on the diluvial glacier of the Aar and its deposits in the neighborhood of Berne, by Professor A. Baltzer of that city. It is a handsome quarto volume of 170 pages and seventeen plates. The text is chiefly concerned with the results of glacial action in the neighborhood of the strong terminal moraines and the included amphitheatre of Belp (just above Berne). This amphitheatre was in general eroded; the moraines outside of it were built up; and the forelying district was broadly aggraded by surcharged glacial rivers. The chief of the latter was the Aar, which shifted its course to the right and left across the foreland, as one part after another was sheeted with sands and gravels. Among the plates special mention should be made of a superb view showing the confluence of the two main glacial branches far up among the mountains, from a photograph by Sella; a pictorial section exhibiting the dimensions of the whole length of the diluvial glacier when it extended even beyond Berne; and several views of the drift topography in the piedment district. The effect of the Rhone glacier in obstructing the natural outflow of the Aar glacier and requiring it to run over the Brunig pass towards Lucerne is clearly set forth. A large two-sheet map of the district about Berne will prove a a valuable guide to foreign students who wish to examine a typical glaciated area in the light of detailed local investigations.

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CURRENT NOTES ON METEOROLOGY.

THE TEACHING OF CLIMATOLOGY IN MEDICAL SCHOOLS.

THE importance of a study of climatology by medical students is urged in a paper by R. DeC. Ward, under the above title, in the *Boston Medical and Surgical Journal* for February 4th. At present very little attention is paid to this subject in any of our medical schools, and a special course in climatology is given in but about half a dozen. Medical men all realize the close relations which exist between climatic conditions and health, but, so long as no instruction is provided for them during their medical course, they are left to pursue the subject as best they can after they begin to practise. In this paper a general outline of

a course in meteorology and climatology, suitable for medical schools, is given, and reference is made to the books which will be found most useful in the work. The writer believes that the subject of climatology is of sufficient importance to stand by itself, as an independent course in the medical curriculum, and that every medical student should have a general knowledge of it. The special relations of climate in the different branches of medicine can be discussed by the instructors in hygiene, or therapeutics, or bacteriology, after the students have the general knowledge just referred to. Correspondence has shown that a large number of the deans of our medical schools favor the giving of some such instruction in climatology in the medical course, and there can be no doubt that all the most progressive schools of medicine will provide such instruction before long.

SUNSTROKE WEATHER OF AUGUST, 1896.

WE are reminded of the exceptionally hot weather which prevailed over the eastern two-thirds of the United States early last August, by a paper by Dr. W. F. R. Phillips, entitled 'Sunstroke Weather of August, 1896,' in the November *Monthly Weather Review*. The opportunity which this extraordinary heat wave offered, of studying the relations of meteorologic conditions and the occurrence of sunstroke, was made good use of by our Weather Bureau, and, as a result of a careful study, Dr. Phillips has been able to draw some interesting conclusions from the large body of hospital and official city statistics collected. The most important results are as follows: (a) the number of sunstrokes follows more closely the excess of temperature above the normal than it does that of any other meteorological condition; (b) the number of sunstrokes does not appear to sustain any definite relation to the relative humidity; (c) although the absolute humidity was greatest during the maximum of sunstrokes, yet it does not appear that the variations influenced the number of cases; (d) the liability to sunstroke increases in proportion as the mean temperature of the day approaches the normal maximum temperature for that day. It is rather striking to find no decided connection between the humidity of the atmosphere and the occurrence of sunstroke. So far as can be ascertained, the whole number of deaths during Augnst, 1896, directly attributable to sunstroke was 2,038.

DEFORESTATION AND RAINFALL.

Nature for January 28th contains a note on the much vexed question of the influence of forests on rainfall. According to a recent *Bulletin of the Royal Botanic Gardens*, Trinidad, the rainfall on that island is slowly but surely decreasing. The average rainfall for the decade 1862–71 was 66.715 inches; for 1872–81, 65.993 inches, and for 1882–91, 65.037 inches. The cause of this decrease is said to be the disappearance of the forests. It would be well, however, to wait a good many years more before coming to that conclusion. Records for only thirty years, even if they are absolutely comparable and reliable, are hardly sufficient to warrant holding such a belief at the present time.

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CURRENT NOTES ON ANTHROPOLOGY.

THE EUROPEAN 'QUATERNARY' MAN.

OUR geologists rarely use the term 'quaternary.' By European writers it is understood to mean the period which followed the Tertiary and includes the present time. Archæologically it is divided into two epochs, the older including the pre-glacial, the glacial and the post-glacial ages, all characterized by a chipped-stone industry; the later beginning with the neolithic culture and continuing till now.

Professor Gabriel de Mortillet, in the *Revue Mensuelle* of the Paris School of Anthropology (January 15), succinctly explains these divisions and sets forth, with his usual clearness, the typical products and the fauna which characterize them. He has found no reason materially to modify the opinions he advanced in his earlier works, and still maintains that a careful study of the geological data bearing on the question of the antiquity of man does not allow us to assign it a more recent date than 230,000 years ago.

THE AFRICAN DWARFS.

In the *Mittheilungen* of the Vienna Anthropological Society, for December, Professor Paulitschke presents his views on the dwarfs of Africa. He referred to the present localities occupied by them, which are scattered from the Atlas chain in Morocco to the Kalehari desert in South Africa. For a variety of reasons, he believes these dwarfs to be the remnants of a distinct race, not degenerates, but a 'sport' (*Spielart*) of *Homo Sapiens*, which at some distant epoch occupied large areas of the continent and extended to Madagascar.

Referring to the Dume, the small people found by Dr. Donaldson Smith north of Lake Stephanie, he regretted that so little information was secured about them. But Dr. Smith did obtain a vocabulary of their language and photographs of two of the males, which are printed in his recent volume of explorations.

D. G. Brinton.
University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

A BILL FOR THE SUPPRESSION OF SCIENCE, LITERATURE AND ART.

The new tariff bill now before Congress imposes a tax of 45 per cent. *ad valorem* on scientific apparatus 'imported especially for colleges and other institutions;' it imposes a tax of 25 per cent. on books imported for public libraries, on books 'printed in languages other than English,' on books 'printed more than twenty years,' and on books 'devoted to original scientific research,' and it imposes a tax of 25 per cent. on works of art. This simple statement is the most severe indictment that can be brought against these provisions of the bill. Argument in such a case seems almost useless.

Import duties are imposed in order to raise revenue and, according to one of our political parties, to protect home industries from foreign competition. Indirect taxes for purposes of revenue are by common consent imposed on those articles whose consumption is not necessary nor useful. Thus the British government collects an import duty only on stimulants, narcotics and silverware. The United States government collects internal revenue only on alcoholic drinks, tobacco, opium, oleomargarine and playing cards. Opposed to such commodities are scientific instruments and books, which contribute the most to the advance of civilization. A single scientific instrument or the book describing it may increase the wealth of the country by millions of dollars. It is inconceivable that any government should deliberately impose a special tax on such an instrument or book for purposes of revenue.

We must suppose that if anyone approve these new duties it is on the ground of protection to home industries—that, for example, they will benefit our instrument makers. But it seems evident that makers of apparatus will be injured by such taxes. If a college must pay 45 per cent. to the government for the apparatus that it imports it will have less to spend on domestic as well as on foreign instruments. If the best models cannot be imported from abroad, and if American men of science are prevented from improving instruments and inventing new ones, the makers of apparatus in the United States will suffer severely.

But a more important consideration remains. Those who believe in the protection by government of home industries undoubtedly must regard as most important the protection of the industry that contributes the most to the welfare and development of the nation. Agriculture, manufactures and commerce depend on sci-

entific work. It is only by keeping fully abreast of the scientific progress of the world and by contributing its share to this progress that the United States can maintain a position equal to that of Great Britain and Germany. We can afford to confine our considerations to material wealth, even though we may regard as far more important than this, health of body, intellectual development and moral balance. Even those who wish to limit the paternal functions of government believe that it should encourage education and science. It seems incredible that a bill intended to protect the industries of the United States, enacted by a party representing a large part of the intelligence of the nation, should contain provisions tending to suppress science, literature and art.

The President and faculties of Yale University have presented a petition against these duties, and this example should be followed by other institutions. Men of science should also write individually to their Representatives in Congress. When the character of such taxes is properly understood, the bill containing them can scarcely be passed by Congress and signed by the President.

GENERAL.

THE forcible arguments urged by Lord Lister and other members of the recent deputation to the British Prime Minister on the question of the establishment of a National Physical Laboratory apply equally to a similar institution at Washington. We may especially call attention to the able advocacy of this plan by Professor F. W. Clarke in this JOURNAL (January 22d). A department that will do for the manufactures and commerce of the nation what the Department of Agriculture now does for the agricultural interests might properly begin with an institution at Washington similar to the German *Reichsanstalt* and the National Physical Laboratory now urged by English men of science.

IN view of the present advocacy of a department of health under our government, it may be worth noting that the *Lancet* commends a similar plan for Great Britain, proposing that there be a minister of health with a seat in the Cabinet having charge of the following departments: (1) The Registration Department; (2) the Local Government Department; (3) the Factory and Workshop Department; (4) the Analytical and Chemical Department; (5) the Veterinary Department; (6) the Public Works and Prisons Departments; and (7) the Lunacy Department.

MR. JOSEPH H. BRIGHAM has been appointed Assistant Secretary of Agriculture. According to the biographical notice in the New York *Evening Post* his qualifications for the office are as follows: "The new Assistant Secretary of Agriculture is a farmer living near Delta, O., in the western part of the State. He has an excellent war record as an officer in the Union army, and is well known in Ohio political circles, having been his party's nominee in several hot fights. Among the agriculturists he is widely known as Master of the Grange, which office he held for some time. He has lectured to granges in all parts of the country, and was warmly endorsed by granges for Secretary of Agriculture. He is six feet five inches tall. In the Harrison administration he was one of the commissioners to negotiate with the Shoshone and Arapahoe Indians for a cession of a part of the Wild River Reservation in Wyoming."

MR. ROBERT T. HILL, of the United States Geological Survey, has just returned from the fourth of a series of annual studies in the Tropical American regions, made under the auspices of Professor A. Agassiz. The present expedition was devoted to a further study of the geology, paleontology and geomorphology of the Antilles, Barbadoes and the Leeward Islands, and their relations to continental problems. Mr. Hill reports that much new and valuable information was obtained upon these subjects.

MR. S. F. EMMONS, also of the Survey, is in South America, under a month's furlough, working in mining geology.

HENRY L. MARINDIN, an assistant in the Coast and Geodetic Survey, has been appointed a member of the Mississippi River Commission.

IT is proposed to erect a memorial to Galileo Ferreris, the eminent student of electrical science, in the Industrial Museum at Turin. A strong committee has been formed for the purpose, including a number of leading Italian

statesmen and men of science. It is intended to make the memorial international. Subscriptions should be sent to Sig. Cav. Zappata, the municipal Treasurer of Turin.

OXFORD University conferred the degree of D. C. L. on Dr. Nansen on March 18th.

DR. FELIX KLEIN, professor of mathematics at Göttingen, received the degree of D. Sc. from Cambridge University on March 11th.

PROFESSOR E. E. BARNARD, of the Yerkes Observatory, has returned to America. Owing to stormy weather the steamship arrived a day late for the annual meeting of the Royal Astronomical Society, but a special informal meeting of the Society was arranged on March 2d for the presentation of the gold medal awarded to Professor Barnard.

GENERAL SEBERT has been elected member of the section of mechanics of the Paris Academy in the room of M. Resal.

M. GAILLOT has been appointed successor of M. Loevy as sub-director of the Paris Observatory.

IT is stated in *Nature* that Professor W. Ramsay has been elected a corresponding member of the Royal Academy of Bohemia and of the Academy of Sciences of Turin.

MR. HERBERT SPENCER, in accordance with his uniform practice of declining honors, will not accept the degree of D. Sc., which the Council of the Senate of the University of Cambridge proposed to confer on him.

A MEMORIAL to Professor Jaccard, who held the chair of geology at the Academy at Neuchâtel until 1895, has been unveiled at the Academy.

A PROFESSOR of natural science is wanted for the Thomason Engineering College, Rurki, in the northwest provinces of India. Applications should be addressed to the Secretary, Indian Office, London.

A SELECT committee of the British House of Commons has been appointed to inquire into and report upon the administration and cost of the museums of the Science and Art Department. Parliament will consider appropriations for a frontage of South Kensington Museum and the use of the electric light in the Natural History Museum.

THE Lowell Observatory has not found the site in the vicinity of the City of Mexico as favorable as had been expected and will be moved back to Flagstaff, Arizona.

DR. MARSHALL WARD, professor of botany at Cambridge, reports that a collection of Pyrenean and Alpine plants, made by the late Mr. Charles Packe, M. A., Christ Church, Oxford, has been presented to the Herbarium, by his widow, Mrs. Charles Packe, Stretton-park, Leicestershire. The specimens, on about 3,700 sheets, are mounted and named, and were for the most part collected by Mr. Packe himself between 1858 and 1893.

PROFESSOR H. C. BUMPUS has arranged for the students of comparative anatomy of Brown University, according to the New York *Evening Post*, an excursion on Narragansett Bay during the spring recess. A steamer has been chartered for the purpose and seventy students are taking part in the work.

THE final sitting of the International Sanitary Conference at Venice took place on March 19th, when the protocol was signed. It will be sent for signature to those governments whose representatives had already left Venice. Turkey signed it with reserves. Besides the ambassadors and ministers of the Powers, the following-named technical delegates have signed the protocol as plenipotentiaries: Dr. Thorne, for England; Professors Brouardel and Proust, for France; Professor Emergen, for Belgium, and Dr. Ruisch, for Holland.

DR. E. H. WILSON, Chief of the Bureau of Bacteriology in the Brooklyn Health Department, secured, some time ago, bacilli of the Bubonic plague and has made experiments with them. He finds that sunlight and desiccation cannot be relied upon to limit the viability of this bacillus under commercial circumstances. The bacilli survived for forty-three days when desiccated. Dr. Wilson consequently holds that rags, mails, ballast and general merchandise coming from infected ports should be subjected at either the port of departure or the port of entry to a thorough system of disinfection.

STATISTICS of the French population for 1895 show a decrease of 17,000. There was a decrease in 1890, 1891 and 1892, but this was at the time attributed to the prevalence of influenza. The birthrate in France, which at the beginning of the century was 33 per thousand, has now decreased to 22.

A CORRESPONDENT of the London *Times*, in reviewing the consumption of intoxicating liquors in Great Britain and Ireland during the year 1896, shows that, as compared with 1895, there has been an increase, costing over six and a half million pounds, the total expenditure being £148,972,230. This is the largest amount ever spent in the United Kingdom for alcoholic liquors, though the annual expenditure per head for the years 1871–78 was greater. The cause of the present backsliding after a temporary improvement is not evident, for it is probable that the number of total abstainers is increasing.

ONE of the English anti-vivisection societies wrote to the Prince of Wales requesting that none of the money subscribed in honor of the Queen's Jubilee should be given to hospitals maintaining laboratories in which experiments are made on living animals. The Prince of Wales replied through his secretary that it would not be advisable for him to enter into any collateral consideration regarding the disposition of the fund. In his original appeal the Prince of Wales had emphasized hospitals as being not only institutions for the relief of suffering, but also places affording a means of medical education and the advancement of medical science.

THE President of the British Board of Trade stated, at the meeting of the Association of Chambers of Commerce on March 10th, that the bill introduced last session by the government legalizing the metric system of weights and measures would be brought forward, but that a compulsory measure could not be carried in the present state of public opinion. It was proposed before the Association, "That, whilst approving of the bill introduced into the House of Commons last session proposing to legalize the use of metric weights and measures, this Association is at the same time of opinion that the bill should be amended in the following respects: (1) That the decimal system as defined in the bill shall be a compulsory subject of instruction in all the elementary schools in the kingdom; (2) that the use of the decimal weights and measures so proposed shall be optional for only two years after the passing of the bill, and shall then be compulsory." This resolution was, however, not carried. A compulsory introduction of the metric system seems to have been regarded as desirable, by the Association, but not as feasible. It was stated by Sir Samuel Montagu, M. P., President of the Decimal Association, that the passing of a permissive bill would encourage the United States to take a further step in the matter and pass a compulsory bill. If that were done Great Britain would have to follow, as a matter of course.

PROFESSOR JASTROW'S letter to this JOURNAL (p. 26) entitled 'a test on diversity of opinion' was republished in the London *Academy*, but under a misleading title. A number of correspondents sent solutions to the *Academy*. But Professor Jastrow would prefer to have answers sent directly to him, as it is his wish not to secure answers to the problem, but data for the study of diversity of opinion, and for this purpose the answers should be independent.

PROFESSOR KARL PEARSON has collected his scientific essays dealing with problems of chance and variation, several of which are of special interest to students of anthropometry and evolution, which will shortly be published in two volumes by Edward Arnold.

THE Clarendon press will publish a series of five books on musical history, under the editorship of Mr. W. H. Hadow, fellow of Worcester College.

THE New York State Library has just issued its seventh annual comparative summary and index of State legislation, covering the laws passed in 1896. Each act is briefly described or summarized and classified under its proper subject-head, with a full alphabetic index to the entries. It is proposed that the eighth bulletin shall consolidate into a single series, with the legislation of 1897, the summaries for the preceding seven years. This material will be closely classified and so presented as to give a

clear view of the general progress of legislation for the eight years ending in 1897.

A second edition of Professor Bailey's 'Survival of the Unlike' having been called for, he has prepared a new preface, in the course of which he thus summarizes his views on heredity and variation: "I conceive the organic creation to have started out with no definite tendencies so far as the corporeal forms of organisms are concerned, but these tendencies have all been developed—heredity amongst the rest—by the environmental necessities of later time; whilst variation or plasticity was a normal and necessary feature of the original form of life, this constitutional elasticity has been constantly bred out by the pressure of circumstances, and the subsequent variation has come to be more and more the result of definite environments. In some groups, in which the decline towards extinction has now well progressed, or when environments are very stable, organisms reproduce themselves with considerable rigidity, so that it may be said that like produces like. In some of the variable groups, which, presumably, have not yet reached the height of their development, it might with equal truth be said that unlike produces unlike. But, in any event, the normal or original fact is conceived to be that unlike produces unlike. At the present time it would be truer to say that similar produces similar." We are glad to learn that Professor Bailey is contemplating a work on the philosophy of the evolution of plants.

The Cairo correspondent of the London *Times* writes that the second annual horticultural exhibition was opened by the Khedive on January 22d. This year an agricultural department was added, comprising exhibits of food, forage, textile and dyeing products from all parts of Egypt. A novelty was specimens of bagging and fine canvas made from the fibre of the sisal agave, the cultivation of which has lately been introduced by Mr. E. A. Floyer, who has established 30,000 plants in various places, and anticipates that after two years their produce will attain important dimensions. The plant requires very little care or irrigation, and can be grown in places unsuited for other crops. The fibre exhibited was decorticated in a hand machine invented by M. Faure, Messrs. J. Planta and Co., Swiss merchants, of Alexandria, who have established a scientific experimental cotton plantation near Zagazig, on which 60 different cultivations are being made, exhibited some of the results of their enterprise in an artistic kiosque, where every detail connected with the plant could be studied. The display of vegetables, chiefly by natives and the youths of the Agricultural College, contained some fine specimens, grown to a considerable extent from imported English seeds, for which a good demand has sprung up. The Finance Ministry's nursery garden at Ghezireh is an active agent in cultivating and distributing economic plants. Immediately after the exhibition it received applications for 5,000 young trees from native cultivators. The show of butter, vying with the best descriptions produced in Europe, was remarkable as representing an industry dating from only three or four years back.

UNIVERSITY AND EDUCATIONAL NEWS.

The late Sir Thomas Elder has bequeathed £155,000 for public objects in Adelaide, including £65,000 for the University.

Mr. W. H. Corbett, the new United States Senator from Oregon, has given the Pacific University, Forest Grove, Ore., $10,000.

The report that the University of Wisconsin had overdrawn its account on the State Fund is incorrect. We are informed on the best authority that the balance to the credit of the University is $40,000.

Wellesley College will receive $3,000 for a scholarship through the will of the late Sarah S. Holbrook.

Funds are being collected for a Joseph Mosenthal fellowship of music in Columbia University, $6,000 having already been given.

Professor H. Wilson Harding, who for 25 years has held the chair of physics and electrical engineering at Lehigh University, will be made professor emeritus at the end of the present year.

BRYN MAWR COLLEGE awards annually three traveling fellowships. One of these has just been awarded to Miss Margaret Hamilton in natural science and one to Miss E. N. Martin in mathematics.

MR. ARTHUR H. PIERCE, Kellogg fellow of Amherst College, has begun a course of lectures on psychology at the College. The Kellogg fellowship is the most valuable in the gift of any American university. The income of $30,000 is given to the holder for seven years, part of the time to be spent in study abroad, and part in residence at Amherst with certain duties as lecturer.

THE New York *Evening Post* reports that the museum of economic geology of New York University has recieved a full series of specimens illustrating the coal beds in the several anthracite basins. Series exhibiting the peculiarities of the ores and enclosing rocks have been sent by the officers of eleven important mines in Montana, Nevada, Utah, Colorado and Arizona, and similar series have been received from several of the more celebrated iron mines. The department of geology has been assigned for the present the south end of the new museum, which is approaching completion. It has a length of between eighty and ninety feet, and a width of over thirty-five feet, and will comprise three sections, namely, the museum section, the laboratory section and the classroom section. The space in the temporary building now occupied by geology will be given to the department of biology.

AN attempt is being made to secure funds for the endowment of a professorship in agriculture and forestry at the University of Cambridge. During the present year a short course of lectures on the practice and science of agriculture have been given by Professor Somerville, of the Durham College of Science.

A DESPATCH to the London *Times* from St. Petersburg says that more than a thousand students of the University and other institutions have been arrested at the very doors of the Cathedral of Our Lady of Kazan. They were endeavoring to attend prayers said for the soul of a girl student named Vitroff, who, it is alleged, set fire to her blanket and burned herself to death in her prison cell, to escape the insults and violence of a prison official. She had been imprisoned since December, on the charge of being a political agitator.

DR. CLASSEN, of the Polytechnic Institute at Aachen, has been appointed professor of chemistry in the University at Kiel; Dr. A. Palladin, professor of plant anatomy and physiology at the University of Warsaw, and Dr. de Vries, docent at the Polytechnic Institute at Delft, professor of geometry in the University of Utrecht. Dr. W. Beneke has qualified as docent in botany in the University of Strasburg.

DISCUSSION AND CORRESPONDENCE.

THE FORMER EXTENSION OF ICE IN GREENLAND.

SINCE the facts in the case will soon be published there might seem to be no especial need of continuing this discussion, but I do not feel that I should leave it while Professor Chamberlin is insisting that I have misinterpreted him. It is *not* a question whether he thought the Upper Nugsuak region had been glaciated, but upon what evidence he has drawn his sweeping conclusion that 'the ice fell short' of half the Greenland coast in a distance of a thousand miles. It would be of interest to know more exactly where the half is, but that is not the point. This conclusion is certainly based upon angular topography, mainly seen from a vessel.

My contention is that this class of evidence by itself is of *no value*, and in proof of this I point out that distinctly angular peaks have been glaciated and, moreover, that one of the most angular now rises in the midst of the Cornell glacier. I have not seen a thousand miles of the Greenland coast, but have seen nearly half that, including the island of Disco, the Waigat Strait and Umenak Fjord. Nowhere in all this distance did I see more rugged topography than that of the Upper Nugsuak peninsula region, *as viewed from the sea*. Professor Chamberlin thinks that the topography on this peninsula is the partly subdued, not the entirely unsubdued upon which he bases his generalization. It would require much more delicately made observations than any of our party was able to make to detect this difference.

The prediction is made by Professor Cham-

berlin that when pronounced upon by 'experts' in glacial topography, there will be seen to be a difference between the two types as illustrated by the photographs. If so, it should be a requisite that such an expert should have been to the top of some of the unsubdued peaks to prove that they have not been glaciated. The mere conclusion based upon a conception of what seems probable should not suffice. I know for my own part that until I got to the top of some of the high peaks on the Upper Nugsuak I could not believe they had been ice-covered; yet I found that the ice had not only covered them, but had extended at least twenty miles further. From my studies the conclusion was forced upon me that isolated peaks, as well as those rising well above the general level, may be glaciated for a long time and still remain very angular.

I am not engaged in an 'attempt' to place Professor Chamberlin in error, as he states, but intend to point out what I believe is an error of judgment. What glacial geology needs above all other things at present is a greater body of fact upon which to base our conclusions. We now have the fact that many parts of the Greenland coast are angular; we have the further fact that a region of angular topography has been glaciated. It is the *truth* that we wish to see discovered, whether this proves that all of Greenland has been glaciated or only a part; but until more facts are obtained I hold that Professor Chamberlin's conclusion that the ice did not extend into the heart of Baffin's Bay is based upon evidence of such a questionable nature that it ought not to be accepted. I, therefore, say again, let us get facts and trust more in them than in 'expert judgment.' When this is done glacial geology will have a better reputation.

R. S. TARR.
CORNELL UNIVERSITY.

So long as Professor Tarr continues to insist that a glaciated and a partially subdued topography cannot be distinguished by its contours, although his own observations show the discriminations of two observers, on separate trips, to have been essentially correct, and so long as he persists in calling a topography unqualifiedly angular which these observers have distinguished from the unqualifiedly angular, it seems idle to continue to discuss the subject. In pursuance of his urgency of the importance of fact and truth and better methods in glaciology there is but one defense which he can properly make, and that is to publish in SCIENCE, whose readers he seeks to influence, the photographs which accompany his Washington paper. Glacialists will then be able to judge for themselves whether glaciation is or is not indicated by the topography.

T. C. CHAMBERLIN.

HISTORY OF ELEMENTARY MATHEMATICS.

IN Professor Blake's appreciative review of my 'History of Elementary Mathematics' there are two or three statements which appear to me open to objection. It must be admitted that, if the logarithm of x be defined by the relation $x=b^{\log x}$, b being constant, then, strictly speaking, Napier's numbers are not logarithms. It is the knowledge of this fact which led me to write in my history (p. 160): "In determining, therefore, what the base of Napier's system would have been, we must divide each term in the geometric and arithmetic series by 10^7." In the light of this remark, my statement that the base 'demanded by his [Napier's] reasoning is the reciprocal of that of the natural system' seems correct. The real question raised by Professor Blake's criticism is this: In considering the matter of a base, what is the best method of describing the nature of Napier's logarithms to a modern student? My claim is that the method of dividing each of Napier's numbers and logarithms by 10^7 and then finding the *fixed* base—a method which I followed in imitation of W. R. MacDonald, M. Marie and others—is more readily grasped by the elementary student than the one involving the difficult notion of a *variable* base, suggested by Hagen and Blake.

The sentence '$\sqrt{2}$ cannot be exactly represented by any number whatever' is correct from the Greek point of view, for on page 29 I say that 'by the Greeks irrationals were not classified as numbers.'

I am unable to find anything on page 74 which would 'lead one to suppose that rigor demands our ability to construct* * *every in-

scribed polygon we may wish to use.' The example in question refers to a problem, to inscribe in a circle a regular polygon of any given number of sides.

FLORIAN CAJORI.

COLORADO COLLEGE,
COLORADO SPRINGS, March 2, '97.

SCIENTIFIC LITERATURE.

Microscopic Researches on the Formative Property of Glycogen. Part I., Physiological. By CHARLES CREIGHTON, M.D., Formerly Demonstrator of Anatomy at Cambridge. London, Adam and Charles Black. 1896. With five Colored Plates. Pp. 152.

Dr. Creighton's work, as stated in the preface to the present volume, has been directed especially to the problem of glycogen in the formative processes of disease, but it was found necessary to turn aside at numerous points in search of a physiological basis or paradigm, and as a result we have the present volume, dealing mainly with the bearing of glycogen on normal growth. Emphasis is laid upon the fact that the glycogen of animal tissues is not destined solely for conversion into sugar, but that in embryonic formations, as well as in pathological new growths, glycogen presents itself in its tissue-making, not its sugar-yielding character. Dr. Creighton's microscopic studies lead him toward the somewhat broad generalization "that the formative property of glycogen is analogous to or parallel with that of hæmoglobin; * * * that glycogen plays the part of a carrier to the tissues; that it contributes somewhat to the building up without losing its own molecular identity; that it is present at the formation of tissues and employed therein without becoming part of them, and that it acts thus, in some cases as the precursor or deputy of hæmoglobin, and until such time as the vascularity of the part is sufficiently advanced; in other cases as the substitute of hæmoglobin from first to last—in those tissues which are built up in whole or in part without direct access of blood."

The observations which lead to this somewhat startling view are made upon tissues, organs or whole embryos, usually fixed in potassium bichromate and hardened in absolute alcohol, the presence or absence of glycogen being determined in the sections of tissue by the usual method of treatment with a weak solution of iodine in potassium iodide. Attention is called to the fact that methyl-violet, contrary to the view frequently held, also gives a distinctive reaction with glycogen, the dye picking out the spots of glycogen from all other parts of the section as distinctively as iodine itself. This method, however, possesses no practical advantages over the iodine method.

Dr. Creighton has studied especially the relation of glycogen to the growth of the bronchial tree and of the choroid plexuses; its relation to the formation of the renal tubules and the development of the intestinal mucous membranes; its distribution in fœtal hoof, nail and hair, and in the developing and functional striated muscular fibre; its relation to the enamelling and cementing of teeth; its presence in cartilage and in the developmental and other immature secretions of the mammary glands, etc. As noted by many previous observers, glycogen is found to be especially prominent in these young embryonic tissues, especially at the centers or points of rapid growth, and at a time in fœtal life when the vascularity of the part is limited or not even established. The point, however, upon which most stress is laid is that glycogen is the dynamic principle in the developing tissue; in epithelial cells, for example, as in the formation of the renal tubules, the glycogen being the precursor of hæmoglobin as a formative agent. Thus, in the tubular formation within the kidney the advancing and differentiating epithelium is supposed to depend mainly, if not solely, upon resources contained within itself, *i. e.*, the glycogen, pending the complete establishment of vascularity, when the glycogen disappears. Similarly, in the muscular tissue of active or mature life, glycogen, like the hæmoglobin, is looked upon as a reserve store for emergencies. Although not essential to the activity of the muscle, it may, perhaps, says Creighton, take the place of the circulating blood in one way as the store or reserve of hæmoglobin does in another, or possibly there may be muscles in which the reserve is chiefly hæmoglobin, and others in which the reserve is mainly glycogen.

The physiologist has no hesitancy whatever

in accepting the view that glycogen is a reserve material of primary importance in the growth and development of new tissues, but it may well be considered whether the theory formulated by Barfurth, that the glycogen so abundant in new growths is a bye-product resulting from the cleavage of complex proteids, ready to be again utilized or stored up as reserve material as occasion demands, is not more consistent with present knowledge than the assumption that glycogen contributes somewhat to the building up of the tissues 'without losing its own molecular identity,' or that it is employed in the growth and development of the tissues without becoming part of them. The very nature of glycogen—certainly, as we ordinarily use the term—is opposed to the stability assumed in the preceding quotation. Far more plausible is the assumption that glycogen is a prominent product of metabolic activity, and as such may be widely formed in all developing tissues, while in the absence of circulating blood, which precludes its immediate removal, it may accumulate for a time in the growing tissues, doubtless being used again in the construction of fresh protoplasm. Indeed, it is so readily decomposable that it naturally constitutes a valuable pabulum for the nutrition or growth and development of fresh tissue. In this sense we can readily conceive of its importance, both as a measure of some forms of metabolic activity and as an aid to new growth, but wholly as a chemical substance which, like other kindred carbohydrates, can be utilized by the living cells which are of necessity the active agents in all growth. But Dr. Creighton, if we understand him aright, attributes to the glycogen of embryonic tissues a kind of intangible power which makes it the forerunner and pioneer of new growths, without loss of its own molecular identity and without becoming an integral part of the tissues.

Thus, in considering the glycogen so noticeable in primordial cartilage it is stated that "one function of the glycogen of cartilage may be guessed to be the separating out of calcareous salts from the protoplasm in such wise that they become visible in the form of granules or vesicular drops. Of course, by far the most of the calcareous matter of bones must come to them direct from the blood; but there is a period of development, the period of transition from cartilaginous moulds, at which lime salts are deposited independently of the blood and in some unknown manner by the agency of glycogen. Assuming that to be a real office of glycogen within the cells of cartilage, it need not exhaust its functions. The diffusion of glycogen through the cartilage-protoplast appears to impart to it a certain mobility or dynamic property, whereby cavities are hollowed out in the matrix and the partitions absorbed in aid of the formation of the central space which the blood-vessels enter and possess. Even when all trace of cartilaginous structure is lost, it appears probable that some of its protoplasm, still occupied by glycogen, is utilized in the form of ostoclasts for the further modelling of the medullary canal or the cancellous tissue. These various uses of glycogen, or purposes to which it may be put, are consistent with the view of it as an intra-cellular or parenchymatous medium, doing duty for a time, or in occasional circumstances, in place of the great internal medium, namely, the blood itself." This somewhat lengthy quotation is a good illustration of the character of the activity or dynamic power which Creighton constantly attributes to the glycogen present in embryonic tissues. To the unbiased reader, however, it would seem that such conclusions are hardly warranted, although it is possible that, in the pathological part to follow the present volume, additional facts will be presented which may tend to strengthen the author's peculiar views. Glycogen may well be considered in the above tissue as a pabulum, which, like the blood itself, furnishes material necessary for the growth and activity of the developing cells, but we fail to see why it should be necessary to attribute to the glycogen a special formative power so radically different from that heretofore attributed to carbohydrate matter in general; a formative power which raises the intra-cellular glycogen to the plane of living protoplasm itself. Its presence in the protoplasm may give to the latter increased activity, may indeed endow it with peculiar and exceptional power for the time being, but it seems far more consistent to consider that the true formative power resides

in the cell-cytoplasm and karyoplasm rather than in the glycogen as a substance by itself. It seems to the writer that the physiologist must demand very conclusive evidence before he can accept the view that "glycogen plays the part of a carrier to the tissues; that it contributes somewhat to the building up without losing its own molecular identity; that it is present at the formation of tissues and employed therein without becoming part of them."

In conclusion, it must be stated that the volume contains a record of most careful observations and that it is replete with interesting and important facts bearing upon the distribution of glycogen in embryonic tissues. Further, due weight must be given to Dr. Creighton's conclusions, although, as already stated, it appears to the writer that physiologists will have some difficulty in accepting them in their entirety.

R. H. CHITTENDEN.
YALE UNIVERSITY.

Analytic keys to the genera and species of North American Mosses. By C. R. BARNES. Revised and extended by F. D. HEALD, with the cooperation of the author. Bull. Univ. Wis. Sci. ser. I., 5, pp. 157–368, 1897.

This bulletin is the 3d edition of analytical keys of mosses published by the author. The first edition, published in 1886, included only the genera recognized in Lesquereux and James' Manual. To this was added in 1890 keys to the species, including descriptions of those published since the issue of the Manual. During the past decade there has been great activity in the study of North American mosses, which is shown in the description of 603 species and varieties since the publication of the Manual and up to January 1, 1896. The present bulletin includes besides the analytical keys descriptive of these 603 species and varieties as an appendix.

As a basis for the nomenclature used in the work the author has followed Renauld and Cardot's *Musci Americæ Septentrionalis*, preferring to do this rather than make new combinations which would necessitate the citation of the 'Analytical Keys' in future taxonomic work. The former keys have been very useful to bryologists in this country, and students of the mosses have been further placed in debt to the author by this comprehensive revision of the work.

GEO. F. ATKINSON.
CORNELL UNIVERSITY.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, FEBRUARY–MARCH, 1897.

Professor Geikie's Classification of the North European Glacial Deposits: By K. KEILHACK. The classification proposed in this *Journal* by Professor James Geikie, in which six glacial epochs separated by five interglacial epochs are recognized, is criticised. In its place is offered an unofficial announcement of the results of the detailed mapping carried on by the Royal Prussian Geological Survey.

The Average Specific Gravity of Meteorites: By O. C. FARRINGTON. Account is taken of both the weight and the specific gravity of 142 specimens which give an average of 3.69.

Drift Phenomena in the Vicinity of Devil's Lake and Baraboo, Wisconsin: By R. D. SALISBURY and W. W. ATWOOD. The region studied is on the eastern edge of the Driftless Area where the Wisconsin ice pushed out over certain high quartzite ridges. The rough topography (900–1600 A. D.) lead to certain exceptional phenomena in connection with the drift border. The ice mounted the high ridges but halted on the summits in a most peculiar manner. The edge of the ice is marked by a moraine of the character known as 'Endmoräne' by the Germans. Where it crossed the 'Devil's Nose' the slope of the upper surface of the edge of the ice was measured and found to be about 320 feet per mile. This measurement has the exceptional interest of being the first recorded measurement at the extreme margin of the ice. Skillett creek was diverted by the filling up of its lower course by the overwash; the Baraboo was dammed and a temporary lake was formed, and on the east quartzite bluff a smaller lake was formed which finally became extinct by the complete filling up of its basin.

Comparison of the Carboniferous and Permian Formation of Nebraska and Kansas, II.: By CHARLES S. PROSSER. A continuation of the author's paper in the preceding number of the *Journal*. The Nebraska City section is quite

fully discussed and the exposures of Cass county are treated in detail.

The Geology of the San Francisco Peninsula: By Andrew C. Lawson. A retort to the criticism appearing in the preceding number of the *Journal*, of the author's paper, by H. W. Fairbanks.

Note on the Geology of Southwestern New England: By Wm. H. Hobbs. The structure of the apparently anticlinal ridges of Berkshire schist was studied in the ridge of schist immediately to the south of the east Twin Lake in the township of Salisbury and in the mass of Tom Ball near Housatonic village. The observations obtained have been sufficiently numerous and reliable to show that the folds are either overturned anticlines with easterly dipping axial planes or nearly recumbent *fanned* synclines with the axial planes inclined to the eastward. The ridge south of Twin Lakes was followed southward into Watewanchu Mountain, where the limestone can be seen to pass under the schist on the end of the fold. This latter locality is, therefore, a crucial one and shows that the apparent anticlines of schist are nearly recumbent synclinal folds with the necks compressed so as to produce a fan structure.

Studies for Students. Deformation of Rocks V. Supplementary Notes: By C. R. Van Hise. Notes supplementary to the author's recent papers with reference especially to the following topics are given: Separation of the outer crust of the earth into zones; Plastic flow produces folding; Complex folds; Monoclinal anticlines and synclines; Position of cleavage in anticlines and synclines; Relations of cleavage produced by shearing and shortening; Relations of cleavage and fissility to faults; Relations of joints to bedding; and Relations of joints to folds.

H. F. B.

AMERICAN CHEMICAL JOURNAL, MARCH.

On the Decomposition of Diazo Compounds: By John J. Griffin. The author has studied the reaction of ethyl and methyl alcohols with paradiazometatoluenesulphonic acid in the presence of various substances, as sodium methylate, sodium carbonate, sodium hydroxide, zinc dust, calcium carbonate, sodium ethylate and ammonia. When diazo compounds are decomposed by alcohols, one of the products formed contains either hydrogen or an alkoxy group in place of the diazo group. The influence of temperature and pressure on this reaction has been studied with a number of diazo compounds, and the present research was a continuation in this line. When the substance under investigation was decomposed in alcohol in the presence of an excess of some alkali and zinc dust, only the hydrogen reaction took place; that is, the diazo group was in all cases replaced by hydrogen, the nature of the alcohol in these cases having little, if any, influence on the reaction. When the decomposition took place in alcohol saturated with ammonia, the ammonium salt of paratoluidinemetasulphonic acid was formed. The product in each case was converted into the amide and separated by crystallization. The properties of this amide were studied, and some of it was oxidized to metasulphaminebenzoic acid, and its properties and those of its salts were also studied. The only exception noted was with calcium carbonate, which had no influence on the diazo decomposition.

The fact that pure metatoluenesulphonamide could be made in any desired quantity by these reactions suggested transforming it into the acid, to settle the contradictory statements which have been made about its properties. The pure acid and a number of its salts were prepared, and the results indicated that the substances hitherto obtained had not been pure.

On the Colored Compounds Obtained from Sodic Ethylate and Certain Aromatic Nitro Compounds: By C. Loring Jackson and M. H. Ittner. A number of investigators have observed and studied the strikingly colored substances formed by the action of alkaline solutions on certain aromatic nitro compounds. Some of these colored substances have been isolated and analyzed and some light has been thrown on the conditions governing their formation. The authors have prepared and studied the action of about fifteen complex nitro compounds. The duration of the color varied from a few seconds to hours, related substances behaving in general alike. The explanation advanced by Victor Meyer, that these compounds are salts formed

by the replacement of an atom of hydrogen of the benzol ring by the metal, is not applicable here, as he considered the hydrogen replaced to be the one between the the nitro groups. In the compounds here studied this position is occupied by other groups, but it is perhaps the hydrogen between the nitro and carboxyl groups which is replaced. The evidence, however, is not conclusive, as there are facts which support this theory and others which are against it. One of these colored compounds was isolated and studied and some derivatives prepared.

On the Action of Chlorcarbonic Ethyl Ester on Formanilide: By H. L. WHEELER and H. F. METCALF. The authors have given in a recent number of this *Journal* the method of preparation of formylphenylurethane. According to some authors this breaks up, giving an amidine and other products. The authors show that the oil obtained by Freer and Sherman in this reaction was not, as they stated, ethylisoformanilide, but a mixture of several compounds. They also succeeded in isolating a number of other final reaction products. The structure of formanilide is represented in two ways, either as an anilide or as an imido compound, phenylimidoformic acid. The structure cannot be determined by the final reaction products, as the formation of all the compounds can be readily explained by either structure. According to the authors the weight of evidence from recent work favors the imido-acid structure.

Notes of Student Work from the Laboratory of Analytical Chemistry, University of Virginia: By F. P. DUNNINGTON. Analyses are given of a variety of Ilmenite; of 'Mineral Tallow' from Vermont; of Marble from Texas, Md.; of Alum Water from Lee county, Va., and of Infusorial Earth. A number of determinations were also made of the power of certain calcium and magnesium salts to absorb and retain water. No regularity in the amount lost in certain time could be detected, different salts requiring different times to be dehydrated. The formation of definite hydrates by absorption of water could not be established by a study of the amount taken up.

The Proteose of Wheat: By T. B. OSBORNE. The author calls attention to certain wrong assumptions which Mr. G. E. Teller had made in a recent article in this *Journal*, and also to a fact he had overlooked in quoting the author's work. The following books are reviewed: An Introductory Course of Quantitative Chemical Analysis, with Explanatory Notes and Stoichiometrical Problems, H. P. Talbot; A Simple Method of Water Analysis, Especially Designed for the Use of Medical Officers of Health, J. C. Thresh; The Gases of the Atmosphere, The History of their Discovery, W. Ramsay; A Manual of Quantitative Chemical Analysis for the Use of Students, F. A. Cairns. An obituary notice of Eugene Baumann is also contained in this number.

J. ELLIOTT GILPIN.

THE ASTROPHYSICAL JOURNAL, NOVEMBER, 1896.

A Further Study of the effect of Pressure on the Wave-lengths of the Lines in the Arc Spectra of Certain Elements: By W. J. HUMPHREYS. In their previous work along this line* Messrs. Mohler and Humphreys investigated the spectra of twenty-three elements. The present paper covers experiments upon some twenty-three more. With some exceptions, the results of the previous investigations were verified. In particular, the law that the shift is proportional to the pressure into the wave-length of the line considered was found to hold. In this connection it was found necessary to divide the strontium and barium lines into two groups, as had been done with calcium. The relation of the shift to the position of the element in its Mendelejeff group is also discussed.

Prominences Observed August 8, 1896: By J. FÉNYI. Observations of the prominences are given as being of possible interest in connection with the solar eclipse of the above date.

Notes on a Method of Determining the Value of the Light Ratio: By ALEXANDER W. ROBERTS. A discussion of a method of determining the light ratio for a system of magnitudes. That is if the magnitudes of a number of stars are given, with an unknown light ratio between the magnitudes, a method is suggested by which from an estimation of the magnitude of two superimposed star discs the ratio may be determined. A discussion of algol variables follows.

*Ap. J. February, 1896.

The Modern Spectroscope XX. On a New Fluid Prism Without Solid Walls and its Use in an Objective Spectroscope: By F. L. O. WADSWORTH. The writer suggests that a plane mirror slanting downward at the proper angle be introduced into the dispersing fluid, and that the level surface be made to form the face of the prism. The arrangement is similar to that in the Lettrow form of spectroscope.

Preliminary Table of Solar Spectrum Wave-lengths: By HENRY A. ROWLAND. One of the regular series of tables.

Researches on the Arc Spectra of the Metals III. Cobalt and Nickel I. One of the regular series of papers by B. HASSELBERG. The measurements of the wave-length are discussed and probable impurity lines eliminated.

Minor Contributions and Notes—Recent Astrophysical Publications.

DECEMBER, 1896.

Oxygen in the Sun: By C. RUNGE and F. PASCHEN. In the oxgen vacuum tube there exists a triplet: λ 7772.26, 74.30, 75.97, which is also found in the solar spectum. As the solar spectrum is comparatively weak in lines in this region (which is on the outside edge of the red) the chance of coincidence with lines of foreign origin is less than elsewhere. It is therefore suggested by the writers that observations upon these lines be made, to determine their solar or telluric origin, whichever it may be. If the origin be solar the writers believe the existence of oxygen in the sun will be proved.*

The Algol Variable + 17°4367; *W. Delphini:* By EDWARD C. PICKERING. An ephemeris and light curve for the star.

The Determination of the Various Quantities of Aqueous Vapor in the Atmosphere by Means of the Absorption Lines of the Spectrum: By L. E. JEWELL. An investigation of the relative intensities of the water vapor lines on the red side of the D lines, in connection with meteorological readings.

* Recent observations by Mr. L. E. Jewell at Johns Hopkins University show that the triplet varies in intensity upon different days in the same manner in which the water vapor lines do, thereby indicating that it is due to that substance in the earth's atmosphere and not to oxygen either here or in the sun.

Researches on the Arc Spectra of the Metals III. Cobalt and Nickel II: By B. HASSELBERG. A continuation of the details of comparison by which impurity lines are eliminated from the spectra of these elements.

Minor Contributions and Notes. Including H. C. O. circulars No. 12, 13 and 14. No. 13 contains a description of the spectrum of Puppis. This spectrum in addition to dark hydrogen lines and the line K contains a series of dark lines that are satisfied by Balmer's formula less a constant term.*

JANUARY, 1897.

On the Spectroscopic Binary α^1 Geminorum: By A. BELOPOLSKY. Containing an account of the detection of the binary character of the principal component of castor. A general discussion of the elements is also included.

On an Automatic Arrangement for Giving Breadth to Stellar Spectra on a Photographic Plate: By WILLIAM HUGGINS. Dr. Huggins suggests in this article that an eccentric gear wheel be put in the clock mechanism so as to produce an oscillation of the telescope during exposure. This will cause the stellar image to move back and forth over the desired length of slit. The advantage claimed for this method, over the one ordinarily in use (that of changing the rate of the clock, which was also due to the writer), is the saving of time ordinarily wasted in the resetting, and in general convenience.

On the Application of Interference Methods to the Determination of the Effective Wave-length of Starlight: By GEO. C. COMSTOCK. An investigation taken up in connection with the effect of refraction upon the apparent places of stars. The author claims that for physiological reasons the effective wave-length can not be determined by matching the apparent color of the stars with the spectrum. The following device was adopted. The objective of the equatorial was covered by a diaphragm having two parallel slits cut out of it. When the telescope was pointed at a star there resulted the usual dif-

* More recent investigations by Professor Pickering, and Professor Kayser, indicate that this second series is also due to hydrogen under physical conditions different from those under which it has been previously observed.

fraction pattern, consisting of a central band with a series of fainter ones ranged symmetrically on each side. The most distant of these resembled faint stars, and were of course due to the more intense part of the stars' spectrum. The distance of one of these bands from that symmetrically situated on the other side gave the data for the determination of the wave-length. The measurements were made directly with a micrometer.

Remarks on the Articles of Mr. E. J. Wilczynski: By PAUL HARGER. Being rather a spirited attack upon the validity of some of Mr. Wilczynski's assumptions in connection with his work on Solar Rotation.

Researches on the Arc Spectra of the Metals III. Cobalt and Nickel III: By B. HASSELBERG. One of the regular series of papers dealing with the measurement of lines and the elimination of impurities.

Preliminary Table of Solar Spectrum Wave-lengths: By HENRY A. ROWLAND. Minor Contributions and Notes. Reviews of Recent Astrophysical Literature. Bibliography of Recent Astrophysical Literature.

SOCIETIES AND ACADEMIES.

TORREY BOTANICAL CLUB.

AT the regular meeting of February 9th, about 200 persons present, the scientific program consisted of a lecture by Mr. Henry A. Siebrecht, entitled 'Orchids; Their Habitat, Manner of Collecting and Cultivation,' handsomely illustrated with lantern slides by Mr. Cornelius Van Brunt, colored by Mrs. Van Brunt.

Mr. Siebrecht in his paper referred to the hardships undergone by the orchid collector, and paid a tribute to the energy displayed by three friends of the speaker, Carmiole, an Italian, who had come to New York when the speaker was a boy; Föstermann, who died about two years ago, the victim, like most collectors, of disease contracted in that enterprise; and Thieme, who had made three trips for Mr. Siebrecht, and who went last to Brazil in search of the *Cattleya autumnalis*, but was never heard from.

Mr. Siebrecht referred also to three trips of his own in quest of orchids, to the West Indies, Venezuela, Brazil and Central America. He then exhibited the lantern views, which were of remarkable beauty and evoked frequent applause. They included numerous representatives of the chief tropical genera cultivated, also with views of interiors showing the Cattleya house in full blossom, etc. Slides showing numerous species native to the Eastern United States followed.

Mr. Siebrecht then described the culture of orchids and classed their diseases, as chiefly because too wet, when the 'spot' closes the stomata, or too dry, when they collect insects. He referred to their insect enemies at home, the 'Jack-Spaniard,' which eats the marrow from the bulb, and Cattleya-fly, now introduced into English houses. He mentioned the ravages of *Cladosporium* and the great difficulty with which orchids of the genus *Phalænopsis* are preserved from fungal diseases.

The subject was further discussed by the President, Dr. Britton, Mr. Samuel Henshaw and Mr. Livingston, the latter referring to his recent experience as an orchid collector. A slide was exhibited, made from a photograph taken by Mr. Livingston, showing his orchids packed upon oxen and so carried down from the mountains to Magdalena.

Mr. Henshaw spoke of his visit to Mr. Siebrecht's nursery in Trinidad, and of the growth made there by Crotons, as much in one year as here in four or five. In those gardens they divide their plants by rows and edges of Crotons, which are sheared off as we would trim a privet-hedge. Mr. Henshaw also paid a deserved tribute to Mrs. Van Brunt for the wonderful success of her coloring of the orchid slides.

EDWARD S. BURGESS,
Secretary.

SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

AT the meeting on February 22, 1897, Professor F. H. King, in a paper 'The Movements of Ground Waters,' referred first to a world-wide zone, probably extending as deeply below the surface of the earth as rock fissures exist, and which is interpenetrated with water incessantly in motion. These movements were classified as

gravitational, thermal and capillary, due respectively to fluid pressure, osmotic pressure and surface tension. Charts were presented constructed from automatic, continuous records, showing that the ground water is constantly in a state of oscillation which may extend over a long period, may be seasonal, or may correspond with the high and low barometric waves associated with the movements of storms. The records presented show that the surface of the ground water in a well is much more responsive to atmospheric changes of temperature than the barometer itself, and during stormy weather the movements of the water surface are so complex and so short in period that a rapidly moving chronograph is required to separate them. Data from different wells and springs strongly suggest the existence of a lunar ground-water tidal disturbance. The variations in the rate of discharge of water from springs under barometric changes is very great, and the surface of Lake Mendota has been shown, even in winter when covered with ice, to be subject to extremely complex oscillation, some of which appear to be barometric. Professor C. R. Barnes, speaking on 'An Evolutionary Failure,' first discussed the meaning of the title, holding it applicable to those groups of organisms which do not give rise to higher forms. The evolutionary history of the mosses was briefly traced, showing that their ancestors diverged along two lines, one of which culminated in the mosses and the other in the seed plants. The cause of failure in the first case seems to have been due to the retention from lower stages of the two most important functions, nutrition and sexual reproduction, by the gametophyte; while success was attained in the other line by specializing the sporophyte for nutritive work.

W. S. MARSHALL,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on March 15, 1897, President Gray in the chair, present also thirty-five members and guests, a portrait of Dr. Enno Sander, who for the past thirty-five years has served uninterruptedly as its Treasurer, was presented to the Academy. Dr. Hambach spoke entertainingly and instructively on what a geologist may find of interest about St. Louis, exhibiting specimens of the principal fossils and minerals characteristic of the local deposits, and indicating the best localities for the collection of certain specimens. One person was admitted to active membership.

WILLIAM TRELEASE,
Secretary.

SCIENCE CLUB OF NORTHWESTERN UNIVERSITY.

AT a meeting of the Club held March 5th, Professor William Locy read a paper on the 'Primitive Sense-Organs of Vertebrates and their Relations to the Higher Ones,' of which the following is a synopsis:

The sense-organs differ from one another mainly in degree of differentiation and specialization. They may be regarded as forming a series at the lower end of which are the simplest sensory papillæ, and at the upper end the highest developed sense-organs. From the combined results of investigations on both invertebrates and vertebrates it seems probable that the higher sense-organs have been derived from those of a lower order, and that they have all been differentiated from a common sensory basis, and, therefore, are related in a direct way.

In vertebrates the sense-organs of the lateral-line system are the most generalized, and it seems probable that from these most of the others have been derived. Especial attention was directed to the earliest rudiments of the vertebrate eye, and the bearing of the facts on the phylogenetic history of the eye, was discussed.

THOMAS F. HOLGATE,
Secretary.

NEW BOOKS.

A Treatise on Rocks, Rock-weathering and Soils. G. P. MERRILL. London and New York, The Macmillan Company. 1897. Pp. xx+411. $4.00.

An Outline of Psychology. EDWARD BRADFORD TITCHENER. New York, The Macmillan Company. 1897. Second Edition. Pp. xiv +352. $1.50.

The Aurora Borealis. ALFRED ANGOT. New York, D. Appleton & Company. 1897. Pp. xii+264.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, APRIL 2, 1897.

CONTENTS:

The Relations of Science and the Scientific Citizen to the General Government: J. R. EASTMAN 525

The New York State Science Teachers' Association (III.), including Address by Thomas B. Stowell: FRANKLIN W. BARROWS.....531

Migration of Bats on Cape Cod, Massachusetts: GERRIT S. MILLER, JR.....541

Zoological Notes:—

Museums and Science; A Dog of the Ancient Pueblos: F. A. LUCAS.....543

Current Notes on Anthropology:—

European Ethnographical Museums; Ethnographical Survey of Great Britain: D. G. BRINTON...545

Notes on Inorganic Chemistry: J. L. H.....545

Scientific Notes and News:—

The Threatened Legislation against Science and Education; General.....546

University and Educational News.....549

Discussion and Correspondence:—

Relations of Tarsius to the Lemurs and Apes: A. A. W. HUBBRECT. *The Journal of School Geography:* W. M. DAVIS, RICHARD E. DODGE. *The Drainage of the Saginaw Valley:* ALFRED C. LANE.....550

Scientific Literature:—

Newton's Dictionary of Birds: ELLIOTT COUES. *Recent Geological Bibliographies:* H. F. BAIN. 553

Societies and Academies:—

Chemical Society of Washington: V. K. CHESNUT. *Geological Society of Washington:* W. F. MORSELL. *Entomological Society of Washington:* L. O. HOWARD. *New York Academy of Sciences:* RICHARD E. DODGE.....557

New Books.....560

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE RELATIONS OF SCIENCE AND THE SCIENTIFIC CITIZEN TO THE GENERAL GOVERNMENT.**

IN the founding of states, and in the early stages of that development of local and general government that rests on new principles or on novel combinations of well recognized theories, the stress of individual and collective effort for simple existence is the dominant factor in the community. Under such circumstances the systematic investigation of natural phenomena can have no place in the occupations of men, nor receive recognition in those fundamental laws that set forth the rights and the duties of the citizen and the powers of the state.

Republics are born of the impelling desire for the greatest good for the maximum number of citizens, and that democratic impulse reaches its highest activity only when community of interest and comparative equality of estate and station characterize the members of the body politic. With the material development of states the varied energies and capacities of individuals soon introduce aspirations for higher knowledge and also those combinations for wielding financial power which are inseparable from all highly organized communities; and such forces, in their turn, demand not only the practical application

* Read before the Philosophical Society of Washington, D. C., February 6, 1897.

of scientific methods in every direction, but they are satisfied with nothing less than the latest and best results of scientific investigation.

While this is generally true of the evolution of all states and nations, it is especially characteristic of the progress of our own Republic.

During the existence of the English-speaking colonies in what is now known as the United States of America, the independence of the various colonial governments, the slow and uncertain means of communication, and the general lack of wealth throughout the land, not only furnished no stimulus to scientific activity, but presented effectual barriers against all continuous devotion to scientific investigation. Up to the time of the War of the Revolution the schools and colleges of the colonies would have been held guiltless of wasting any time on the natural sciences. At that time, also, there was no attempt in any of the seats of learning to teach anything but a smattering of mathematics and the physical sciences.

In 1787 science was not recognized by the individual or by ethical, social, educational or political organizations as a prominent factor in intellectual or material progress. In the old and wealthy states of Europe the pursuit of mathematical studies had opened the way for the development of the physical sciences; but on this continent the study of algebra, the basis of mathematical analysis, had not acquired a respectable standing in even the best colleges, while in most of the educational institutions of the land the subject was entirely neglected, if not unknown. For that reason alone, the physical sciences could have no place or influence in the thoughts of the people who formed our Federal Constitution.

Without recognition in the organization of the general government, science was left to fight its way along its own lines; struggling at first to reach practical results rather than fundamental laws; sometimes failing and often uncertain in its aims, but still untrammeled by the fetters of bureaucratic domination.

The State, Treasury, War, Postoffice and Law Departments of the general government were organized in 1789; the Navy Department in 1793, the Interior in 1849 and the Department of Agriculture in 1889. The real or fancied needs of a government devised to promptly respond to the widely divergent interests and activities of an energetic people soon made it necessary to have under its own control some of the means for producing results by the best known scientific methods.

In a halting and half-hearted way a number of attempts were made to lay the foundations of scientific attachments to some of the executive departments. These centers of scientific activity were set in motion by widely different influences, though all were united apparently in seeking immediate and practical accessions to the material welfare of the country.

When considerable progress had been made in the installation of these new ventures it was found that the men of scientific training, the only proper personnel for such work, were not to be found in this country, and the development of the scientific worker, under more or less incompetent direction, was the first obstacle to be overcome. With that remarkable adaptability and energy which has characterized the American mind in its struggle with the forces of nature during the last century, the men for prosecuting the work of these new establishments were found and were mostly trained in this country.

That the best plans and the most efficient methods were not always adopted was to be expected, but it may be truthfully said that in the short space of fifty years the generosity of our general government so fully met the demands of the people for

scientific work and investigation that the cost of buildings and apparatus, together with the apparent propects for immediate and valuable results, compels a not unfavorable comparison with the progress of two centuries in the older and more wealthy countries of Europe.

That these achievements were not all real or highly satisfactory was not altogether the fault of the scientific men who zealously labored in the good cause. Under a monarchical or paternal form of government the nominal head possesses the power and assumes the responsibility. The heads of departments and the directors of public works are given certain powers and are held to a rigid accountability. An *ideal* republic might enjoy similar advantages, but a republic *in esse* is not always so fortunate.

Theoretically, all citizens of a republic owe their government equal and faithful service; but actual equality of individuals under any form of government, save in regard to the right to protection of person and property under the law, is a myth, a weak survival of the time when popular sentiment misquoted reason in the arena of practical politics. Out of this erroneous theory, however, has grown in our Republic a somewhat hazy and ill-defined feeling that any citizen is competent as an executive, an administrator, a legislator, a jurist or a director of scientific investigation.

This nebulous but popular belief in the varied aptitude of our citizens has in many instances resulted in serious damage to some of those centers of scientific work which come under the control of the Government.

For many years the political theory that 'to the victors belong the spoils' cast its baneful influence over the scientific as well as the business branches of the executive departments, and social and bureaucratic, leagued with political, influences left few positions for the unfortunate men of science who were forced to rely on the power of their own accomplishments.

Another and by no means a minor factor in the relations of science and the Government is a popular notion of the status of the scientific investigator in society in this country. From one standpoint he is regarded as a human prodigy, gifted beyond his fellows, able to fathom all the subtle mysteries of nature; one by whom all moral and social as well as physical problems are readily solved with more than ordinary human certainty. On the other hand, when the practical politician, or some other fortunate man born to direct affairs, assumes the direction of a branch of the government service he looks upon the scientific man as a more or less harmless eccentric, a feeble specimen of manhood, but, unfortunately, sometimes necessary to the existence of his bureau. Pity for his assumed helplessness is mingled with crude flattery in such proportions as are deemed expedient to secure the necessary professional work, while at the same time the unhappy man of science is assured that he is peculiarly fortunate in having the guidance and protection of a man of affairs who knows the ways of the world.

It is hardly necessary to say that, as a matter of fact, both these extreme views of the scientific man are usually wrong. In general he differs from his fellows only in the possession of some peculiar aptitude or talent for study or investigation in some department of science. He may be a good chemist, and shirk every duty of a good citizen; a learned mathematician, with manners and tastes that bear no trace of gentle breeding or moral training; a gifted biologist, but with a selfish greed that puts him out of touch with the best citizens, the wisest government or the true unselfish seeker after truth in any sphere of human endeavor; in short, the manifestation of ability in scientific pursuits, as in other

walks in life, does not necessarily imply the possession of good morals or the other qualities that make the good citizen. The true scientific man *ought* to be the highest type of moral and patriotic development, since, above all other men, he should fully recognize the unfailing logical relation of cause and effect.

The sooner he is freed from the injustice of absurd flattery on the one hand and ignorance and vicious criticism on the other, and is permitted or obliged to stand on his own merit as a citizen and as a scientific worker and investigator, the better it will be for science and for our country.

Again, the real scientific man has no more need of a business manager than has a lawyer, a doctor or any other professional man. From observation and from experience gathered in the service of the Government for a third of century, I am convinced that the genuine scientific men in the Executive Departments and throughout the country have as much executive and administrative ability as any other class of citizens in the land.

The nature of their interests and pursuits tends to make them less demonstrative than most other men, and in their own ranks those who make the most display and noise in the public press and otherwise are generally least effective as investigators or as directors of real work.

Organized as most of our Government scientific bureaus are, subject to a change in the controlling force, at least every four years, it would be strange, indeed, if the individual members, from their almost constant contact with the practical politician, did not unconsciously acquire some of the habits of thought and action of those who have learned to so manipulate the primaries that the final outcome of an apparently free election shall result in purely personal rather than public advantage.

That some scientific men have not entirely avoided this contagion may be inferred if one studies the methods sometimes employed to obtain the influence that recommends candidates for important positions and that frequently controls such appointments.

The usual remark in such cases that, "after all, scientific men are only human," is not sufficient excuse for any man whose first duty is to be a good citizen.

In Washington one frequently hears the complaint that the scientific man does not receive that respectful consideration from the Government which he really deserves. One also hears in this connection an uncomplimentary comparison between the honors bestowed upon scientific men under our republican Government and those conferred upon their fellows by the imperial rulers of foreign nations. That there is some truth in these views may not be wholly denied, but it should be remembered that, to a great extent, in this country, as in all others, the scientific men have this matter under their own control.

Many times in every year the executive and administrative officers of our Government find it necessary to ask for the opinions and counsel of scientific men. Frequently these same men feel moved to offer their views and advice to the Government, and on all such occasions they have ample opportunity to exhibit whatever unselfish, self-respecting and patriotic characteristics they may possess. If, however, the representatives of the Government find that a body of scientific men have urged the appointment, to a position of trust and responsibility, of one whom they must have known, if they knew the man, was morally and mentally unfit for the place; or if they put in train a scheme for their personal aggrandizement or professional profit, then they have plainly cheapened their own influence and damaged the reputation of all scientific men in the country in the opinion of the

Government officials; and they have no right to complain of lack of appreciation by men whom they have once deceived. Those who would win the respect of others must first respect themselves.

The widely scattered condition of the scientific bureaus of the Government in Washington is sufficient in itself to prevent a normal development of those interests in which the whole country is concerned, and for which important legislation and large appropriations have been urgently invoked

If the opponents of scientific work under the control of the general government had sought for a system that should produce generally the least valuable results for the money and energy expended, it would be difficult to see how they could have devised a plan better suited to their purposes than the one which has existed in Washington for many years.

Until the organization of the Department of Agriculture no change had been made, since the foundation of the Republic, in the custom of founding scientific bureaus or divisions in the various departments, like mission churches on the extreme frontier, with scant visible means of support, and no active, intelligent or discriminating official interest as an effective, sustaining power in the inevitable struggle with adverse legislation and ill-considered, semi-official criticism.

In the fiscal year of 1895–6 Congress appropriated in round numbers $4,500,000 for such scientific work as requires special and technical training in those who carry out the details, and a high degree of scientific knowledge and skill in those who actually plan and superintend the work and finally prepare and present the results to the public.

This amount is very unequally divided between the Treasury, War, Navy, Interior, Agriculture and Labor Departments, and amounts, in the aggregate, to about *one per cent.* of all the money appropriated for these several departments. Considering the total appropriations for each department it is found that scientific work is accorded in the Treasury Department about *one-half of one per cent.*; in the War Department *six-hundredths* of one per cent.; in the Navy Department *seventy-six* hundredths of one per cent.; in the Interior Department *one* per cent., and in the Agricultural Department *fifty-three* per cent.

It should be noted that the Department of Agriculture was organized for a special purpose—to treat the vast interests of agriculture in a technical and scientific manner; and it is the only executive department of the Government whose principal interests and energies are fostered and guided by the methods and the results of modern science.

The highly important duties of a national character which require the daily attention of the heads of the large executive departments naturally occupy all the time at their disposal and absorb their active interest.

Under such conditions it is not likely that the quiet and undemonstrative scientific bureaus can receive the intelligent care and sympathy necessary to their proper development. It can not be said truthfully that this lack of support is due to any fault of the various Secretaries.

It is due primarily to the inherent weakness of a system which, if it ever worked well, in the present crowded and complicated work of the larger departments, now leaves the various scientific bureaus to shift for themselves and permits them to be driven out of the field of consideration in competition with the imperative and legitimate work of such departments.

It is not likely that this unfortunate condition of the scattered scientific bureaus will improve under the present conditions.

This peculiar situation has been a source of considerable anxiety in the minds of many scientific men for the last fifteen

years, and it has not escaped the notice of several thoughtful members of both branches of the national legislature. On January 5, 1888, the Hon. R. W. Townsend, of Illinois, introduced in the House of Representatives a bill 'To establish a Department of Industries and Public Works,' under which should be collected all those bureaus and divisions of scientific work under the control of the general Government, except such as were essential to the distinctive duties of the several existing executive departments.

The author of this bill intended to improve and strengthen all these centers of investigation by bringing them under one executive head, whose sole business would be to protect their rights, provide for their support and represent them with authority before Congress and in the executive councils.

Unfortunately for the scientific interests involved, Mr. Townsend died before his proposition could be considered in the committee to which it was referred; and no comprehensive plan of that nature has since been considered by Congress. The general scheme formulated by Mr. Townsend was approved by scientific men throughout the country, as well as by those in the Government service in Washington, and it has not been abandoned.

It should be said, however, that it has not received the *universal* assent of scientific men either here or in other parts of the country. The scientific man is sometimes swayed by the same motives that influence other people.

If his field of view is limited by the narrow bounds of his own specialty; if he feels certain of getting all he wants for his own particular investigation, or that the present chief of his department is generous to him personally; if he feels that it is more agreeable to rule his small office absolutely while nominally under the control of an easy-going but untrained chief, rather than to help forward the whole cause of scientific investigation; or, if he feels that lack of intelligent supervision enables him to manipulate the affairs of his office for his own immediate, personal reputation, aggrandizement or pecuniary profit; he is likely to prefer the present system rather than one that aims to so arrange and adjust all the scientific bureaus of the Government in such a way that their mutual relations shall be harmonious, and their several interests continually advanced under economical and thorough methods, but without friction or duplication of work.

It is not the object of this communication to point out the selfishness or incompetence of individuals or the shortcomings of bureaus or departments, but to call anew the attention of the members of this society to their relations to the general Government either as citizens or as scientific investigators.

It should never be forgotten that our Government as represented by the Executive, Legislative and Judical powers is simply the agent of the people, not *some* of the people, but *all* of the people, and that they are entitled to the best service to be found within the borders of our broad domain.

To that end it follows that personal claims, clamor of cliques, and the greed and selfishness of those who seek to hold or gain official position, should have little or no weight in the proper organization and control of the scientific work of the Government, where professional merit and adaptibility alone should guide the selection of the personnel, and where practical and theoretical results and investigations, in their proper mutual relations, and controlled by wise economy, should be the single aim of the Government.

It may be exceedingly difficult to fix the time when this desirable consummation shall be affected; but to all scientific work-

ers, both in and out of the public service, who really believe that there has been notable progress along the lines of scientific investigation in this country since 1789, it presents a common goal towards which all may strive; a higher ideal of the relations of science and the government, and a more patriotic conception of the true relations between the intelligent citizen and the government in a genuine republic.

J. R. EASTMAN.

WASHINGTON, D. C.

THE NEW YORK STATE SCIENCE TEACHERS' ASSOCIATION.

III.

THURSDAY, December 31st, two sessions were held in the new Medical College of Syracuse University. The morning meeting was devoted to Biology. Professor C. W. Dodge, of the University of Rochester, read a paper on 'Biological Work in the High School.'* He was followed by Dr. Thomas B. Stowell, of the Potsdam Normal School, with a paper entitled:

The Educative Value of the Study of Biology.

MR. PRESIDENT: Memory of the many days that we have labored together in the Biological Laboratory gives me greater boldness to continue this discussion, for I shall rely upon you, sir, to supply whatever may be lacking in my argument to make sure defense of the cause which I gladly espouse.

I shall outline my idea of the educative value of the biological studies from two standpoints: their value by virtue of the psychology of the study; and second, because of the demands of practical life. And I shall venture to concrete my conclusion by suggesting methods and measures to make this scheme effective and operative.

*At the request of the Association, Professor Dodge repeated this paper, which he prepared last spring for the University Convocation of the State of New York. It is printed in Regents' Bulletin, No. 36, September, 1896, pp. 46–62.

Two problems confront us at the threshold of practical life: the ever present 'bread and butter' problem, type of all utilitarian questions; and processes or procedures to effect desired ends, *i. e.*, the multiple forms of ethical questions whose solution depends primarily upon taste, for I take it that men differ little in conclusions from demonstrable or even from probable premises, which are intellections; the radical difference in men is in taste, or in the emotions which prompt to specific action.

The final cause of study is both cultural and utilitarian; forces or agencies which afford increased facility in developing and in directing the energies or the activities of soul are termed cultural; the results of these forces, that which discovers what is utilized or may be used in every-day life, that which conduces to personal comfort and pleasure, and that which fosters the discovery of such forces and ends are practical, utilitarian.

I shall not contend for the ultilitarian value of the nature studies, for their contribution to temporal comfort, to happiness, to longevity and to prosperity is generally conceded.

The discussion is restricted to the cultural value of such studies. To fit men for life in a broad sense demands such soul-furnishing as will insure correctness in judgment; acquisition of such habits as will guarantee prompt action; and assurance of conduct conformable with the high standards espoused. If I err not, a critical examination of the school curriculum will disclose the fact that its final cause is intellectual acumen rather than moral power; in other words, intellectual activity rather than emotional is the purpose of the schools. I do not decry the schools of to-day; I do not advocate lowered standards, but I urge most persistently the need of culture of the emotional life which is the spring, the source of conduct. Modern psychology has happily

abandoned the hypothesis of faculties, and studies the self, the soul as a unit. This discussion assumes the constancy of the aggregate of soul energy and its non-correlation with radiant energy; in other words, *the number of units of soul energy, potential and kinetic, is constant.* The radical difference then between the educated and the illiterate is in the ratio of potential to kinetic power.

This defines the province of the school, which is to furnish proper stimuli to render active and available the possible, inherent and inherited energy.

There is little debate regarding the order of succession, and the dependence of the forms of mental activity. Admitting that nearly every form seems to be involved or implied in every other form it is customary and convenient to speak of these forms as separate. Following this order, the first end sought in an educative procedure is to effect a sensorial modification, *i. e.*, to produce a definite change in the cortical cells, which change automatically induces a corresponding change in the self or the soul and gives it form or experience, or the precondition of knowledge.

These partial and vague experiences, percepts, must be related, interpreted; they must receive *meaning* which is put into them by virtue of their relations to previous and correlated experiences, else they necessarily remain unintelligible. The condition of experience thus interpreted by the self to the self is what contemporary pedagogics terms appercept, the basis of all clear, definite, positive knowledge.

I have thus briefly outlined the first stages in intellectual activity to get more clearly before this body the reason for my position in my first contention which is:

Contention 1. *That the study of biology is preeminently adapted to awaken those psychoses —forms of soul-activity—which prepare for the demands of practical life.*

I am not prepared to admit that content of mind is secondary in soul development. I am aware that we recall individual and exceptional cases where we have been accustomed to concede great learning with little ability for application; but I am led to raise two questions at the very beginning of the inquiry: 1st. In these cases has the existence of apperceptive scholarship been definitely established? 2d. If this be conceded, has it been shown that under proper stimuli there is the claimed lamentable weakness? I am not contending for restricted specialization, but I do hold that the ignoring of the value of mind content has been and still is a lamentable weakness in the school curriculum. Let me again recur to the primary law of knowledge development, viz: that percepts must be related and interrelated before definite meaning or knowledge can be predicated. The failure to insist upon clear, verifiable forms is a prolific source of superficiality and of baneful habit. Something more than effort is needed. I cannot concur with the traditional dogma that the educative value of a process inheres in the effort. Nerve tracts are not trained to definite and specific response by ill-directed conditions. Meaning cannot be put into new forms from vague percepts. The character of the form acquired is too important to be ignored or even to be relegated to a secondary position.

It seems to me, sir, that a radical defect in educational theory has grown out of a misconception of the nature of so-called mental power. It is a matter of grave moment what is studied, what is known; and it is of far greater importance to heed well the habits formed and the tastes induced. The failure of men who address themselves to the various avocations in life; the numberless wrecks occasioned by futile attempts to occupy positions for which neither heredity nor education has prepared ought to be sufficient demonstration of the fallacy of the 'ef-

fort' hypothesis, and ought to provoke serious controversy regarding the nature of mental power. How long must we observe that success in a given kind of work is no guarantee of success in another, and that expertness in one direction is an almost infallible proof of mediocrity in another, before we shall concede the *specific* nature of mental power. It is this concession which gives preeminence to modern pedagogics. It is impracticable and unphilosophical to talk about symmetrical development. My contention so far has been to show the superior value of nature study as a source of material for sensuous stimuli which are the basis of all knowledge of the outside world and of its myriad relations; and, furthermore, the source of those stimuli which will induce precise and economic action of nerve centers and nerve tracts, a prerequisite to the formation of habit and taste. I concede the spiritual nature of these psychic forms, but I contend for their physical basis.

Accepting the proposition as established, the question arises by what agencies can habits be induced which will insure promptness and accuracy of execution. The demand of the age is for ability to totalize energy, to focalize power and quickly. This is my second contention: *That in culturing value nature studies are not surpassed by other branches of study.*

Conceding that nature study does not furnish all the data demanded for the solution of all of life's problems, I still hold that the habits induced by their study and, what is of far greater importance, the tastes developed are of superior value in training to manliness. Dr. Kuss says that "the association of conception with ideas and their union with feelings and aspiration is under the control of education." And Dr. Radestock vigorously states that "scientific education is only worth anything and is of vital importance when its actions, powers and means have become firm and steady habits;" and Rousseau, more than a century since in his Emile, "Education is certainly nothing but a formation of habits;" and Locke, a century earlier, "We must expect nothing from precautionary maxims and good precepts, though they be deeply impressed on the mind, beyond the point at which practice has changed them to firm habits." These citations are made in corroboration of what has been advocated. I do not contend that the humanities are wanting as means to the desired end, but by reason of their less sensuous nature they are not as well adapted to form the beginnings of habit which they admirably strengthen and supplement.

My third contention is that *the study of nature is preeminently ethical, since the exactness demanded by all scientific research fosters and necessitates love of truth.*

It seems hardly necessary to mention in this presence the value of nature study as promotive of the habit of truthfulness. That the ethical value of scientific training has been questioned may be referred to the early practice of advocating this study because of the attractiveness of objective and concrete study, until many regarded nature study as a sort of amusement or entertainment. I assume that the larger portion of this audience is connnected with some one or more of the scientific associations of the country. I need but call attention to the character of the papers, and to their criticism to demonstrate the fact that with the student of science *truth is supreme.* With him hypotheses are abandoned as cheerfully and as promptly as they are formed. Experience teaches that this ability to set aside cherished ideas is not easily acquired, but the very inexorableness of nature schools men to place priceless value upon truth. A scientific liar is a misnomer, a self-contradiction.

The importance of the habit of truthfulness is worthy of greater emphasis than the

limits of the paper will permit. I cannot refrain from calling attention to the clearness with which the students of biology learn that the omission of a single step in the treatment of tissue, or even the slightest variation from a specified course of procedure, will invariably modify or invalidate the results attained. This lesson has great educative value in impressing upon the mind the consequences of variation from truth in all procedures, demonstrations or speculations.

Having given so large a portion of my time to the discussion of pedagogical principles, I hasten to the suggestion of modes and measures to make this scheme effective and operative.

Whenever the teacher is prepared by previous training to present the subject of comparative zoology, my experience of 21 years as teacher of biology has convinced me that the best results can be secured with students of high-school grade by beginning with the simplest unicellular organisms and proceeding to the more complex. The pupil who has a clear, definite knowledge of an amœba is prepared to comprehend the structure of complex forms, and with this knowledge he cannot fail to grasp the secret of animal morphology. When some of the more complex forms are studied minutely the problem presents two phases: shall one form be studied minutely, and shall the available time be given to the study of a few types, or shall the study of a single type be less exhaustive and a larger number of types be examined?

I am satisfied that I have secured the best results by the study of many types, for comparative study rendered the knowledge of each type apperceptive, and the enlarged circle of experience gave the enlarged interest based upon enlarged knowledge which cannot exist with a restricted content to the concept. Thus in the study of the cœlenterata we examined not only a simple hydra, but studied one or more complex marine forms, some from actual alcoholic specimens, others by means of charts and diagrams. Polyp, anemone (Metridium), jelly-fish (Aurelia), holothurian (pentacta), sea-urchin (Toxopneustes), sand-dollar (Echinarachnius), brittle-star (Ophiopolis), not only aid in the formation of a correct concept of the Coelenterate type, but the knowledge gained from the study of each makes the study of the others more significant. I do not hesitate to affirm that the examination of half a dozen type specimens carefully dissected by the teacher will give a clearer and better knowledge of the type in one class period than a week's study of a single specimen by an untrained pupil who is vaguely working in the dark, with scalpel and specimen, acquiring habits of wastefulness and slovenly generalizations. Where time and appliances will permit, more individual work is desirable; the best and the most economical mode known to the writer is that inaugurated and followed by Dr. B. G. Wilder, of Cornell University, in what he has happily named Practicums.* But quantity is essential to quality, a principle true in every line of research. Something more than effort is demanded.

After careful training to observation of the significance of homologues it is of great value to let each pupil trace a type structure, *e. g.*, the distribution of a spinal nerve in two or more types, as in the cat, dog, rabbit, and learn the significance of persistence of type-forms. No exercise of mind can be made more conducive to that judicial habit which is essential in every department of life and yet is so rare.

From a utilitarian standpoint all this knowledge of animal structure and function becomes the basis of the study of

* Outline directions for these Practicums can be obtained by addressing B. G. Wilder, Ithaca, N. Y. Price, $1.00.

human anatomy and physiology. The vexed and vexing problem of how to teach the effects of narcotics in our schools can not be solved until our teachers are more thoroughly grounded in the matter to be taught and their profound convictions have awakened corresponding emotion which will result in consistency in instruction and in life.

Time forbids detailed mention even of an outline course of study of botany, the most easily taught and the most available of the biological subjects. It should have a place in every grade from the kindergarten to the University.

I am met with the objection that proper equipment of schools for study of biology and anatomy is expensive. To which I gladly make reply: The equipment of a school for the study of English or of the Classics is expensive, but who ever argued against the study of Latin or Greek because of expense of lexicon or grammar or text, and furthermore the objection is based upon a misapprehension of the facts. It is not necessary to have a museum in every school. Type-forms alone are required. Fresh-water clams, snails, slugs with the convenient salt-water clams are accessible for a few cents, and these furnish the data for the study of the lamellibranchs, their differentiæ and their homologies. Fresh-water and marine lobsters are within reach of every school, and no one will complain because of scarcity of material for the study of insects.

The study of the life history of a common beetle will fix in the mind of the student the relation of environment to life more vividly, hence more availably than tomes of unintelligible literature, made unintelligible because of lack of experience as the foundation of interpretation.

It may matter little whether a stray bone belongs to ruminant or rodent, but it matters not a little whether the boy who finds the bone has awakened in him a desire to know its relation and whether he knows how to proceed to solve the problem. The habit of comparative study, the ability to give just values to data, to weigh evidence, so indispensable to success, but alas, so rare, cannot be over estimated.

Time limitations exclude the discussion of the value of the habit of confidence in ultimate discovery of truth. The attitude of soul with which the student of nature addresses himself to a given task is no less sublime than that with which the Priest of Israel entered the Holy of Holies to have direct audience with the *I Am*. This faith in law, this love for truth, this sympathy with creature and Creator are the birth-right of every child; the school can give it; angels can do no more.

Mr. Charles N. Cobb, of the Regents' office, said that, however desirable it might be to have science taught in our schools by college graduates, the fact is that most of our science teachers are not college graduates. A large part of the science pupils of the State are in the small village schools. Many of the science teachers in these schools are normal graduates. The teacher of science in the normal school may be called on to teach physics, chemistry, zoology, physiology, geology, mineralogy and astronomy. The *established* normal course in this State gives 20 weeks to each of the first two previously mentioned sciences, and ten weeks to each of the others. This is modified slightly by the various normal schools.

The discussion of Mr. Cobb's remarks developed the fact that normal school graduates, prepared in this manner, frequently find their way into the high schools of the State as teachers of science, often, however, against the best judgment and advice of their normal school teachers.

Dr. C. W. Hargitt, of Syracuse Univer-

sity, referring to the lack of adequately trained teachers for the best sort of science work in the schools, said that a bungling or half-hearted teacher will never be able to produce satisfactorily prepared students, whatever time or equipment he may have at his disposal. The teacher who aims chiefly to prepare pupils for *examinations* will be equally unsuccessful. Examinations will take care of themselves if we have teachers whose primary aim is to teach science, to infuse into the mind of the pupil the scientific spirit.

It is gratifying to know that some of our normal school principals enter protest against the disposition to offer science positions to even normal graduates, if their special training for science teaching is inadequate. May it not come within the province of this Association to enter similar protest if necessary, aye more, to exercise a mild though vigilant censorship over the science work of the schools, and seek by every reasonable measure to secure constantly better results.

We must be cautious about placing biology among the exact sciences, or holding out unwarranted expectations as to the infallibility of experimental results. This may be all right in physics or inorganic chemistry; it is unsafe in biological teaching. The very fact that this is, preeminently the living science, having to do with the *occult* processes of *life*, the most distinctive character of which is change, renders many results in biological experimentation exceedingly capricious. Indeed this is one of the very charms of the science. Nor is its educational value any the less on this account.

Superintendent Henry P. Emerson, of Buffalo, spoke on some of the practical difficulties attending science work in the lower grades of city schools. Nature study lacks vitality unless it is begun early. A canvass of the school children in a number of Buffalo schools a few years ago revealed the fact that many of the pupils had never seen a lake, a hill, or the Niagara River. Hereafter every pupil in the fourth grade is to have at least *one* excursion a year, visiting some of the public works, the park and the river front. In the high school, excursion work has been a prominent feature in the study of botany and geology for the past twenty-five years, every Saturday during warm weather being improved systematically for the exploration of the vicinity. It is only by such studies, pursued in this manner, that the artificial and mechanical element of school work can be broken up.

Mr. Arthur G. Clement, of the Regents' office, said that in visiting over 175 schools of this State last year he saw some good science work even in our smaller villages where the teacher is usually one from the normal school.

The Regents have their ideals in regard to the teaching of science, but do not expect to see them realized until schools are more fully equipped. Accordingly the examinations in science are prepared in view of the conditions existing in the schools. It is the intention, however, that the nature of the questions shall indicate to some extent the kind and method of teaching which they hope to see gradually established in the schools, and it is expected that teachers will recognize these hints and act accordingly.

In zoology it is recommended to study a single type in each branch in accordance with laboratory methods. The order of progress should be from the lower to the higher, with constant attention to the increasing complexity of structure and its correlation with increasing differentiation of function from branch to branch. If properly done, this work will necessitate observation, discrimination and comparison, and it will impress the pupil with the idea

that the method of life is from the simple to the complex, which is the greatest lesson to be learned from this study, since it is also the method of growth of all social phenomena.

Professor A. D. Morrill, of Hamilton College, thought that if the colleges and universities knew more of the objects toward which the Regents are striving, and the difficulties with which they are contending, it would enable the colleges and universities to be of the greatest help in the advancement of science in the secondary schools.

The chief requisite for the instructor is to be able to arouse mental activity, to care more for the soul of the pupils than for the amount of knowledge that he can impart to them. Thorough scientific training can often awaken pupils who have been wholly uninfluenced by language teaching. It is not so important what the science is as how it is taught. When pupils are taught to use books and not to worship them they are in a position to begin to learn. But the laboratory is of no value except as a means to an end—the awakening of the pupil.

Professor R. E. Dodge, of New York, was glad to notice the emphatic disapproval of systematic botany and zoology. In the study of biology interest can be at once elicited by showing that all living things are attempting the same tasks of life in different and yet similar ways. Function as producing form, comparative morphology and forms as the result of function, should be studied in the early years of education. Thus a basis for interest and better love for nature can be aroused through the sympathy that comes from understanding.

Professor Warren Mann, of Potsdam Normal, was sure that if the same quantity and quality of work were given to science that are now given to languages the results would be equal to or even better than those in language courses. He would not cry down the languages, but he would cry up the sciences until they have an equal footing in all respects with the languages. The next ten years will witness great strides in science study. This Association should be one of the means to that end.

Professor B. G. Wilder, of Cornell, admitted that after thirty years of teaching he still found it dificult to determine the proper sequence of biological subjects and the manner in which they should be presented. He warmly commended the address of Professor Wm. North Rice, 'Science Teaching in the Schools.'* He heartily agreed with Professor Rice as to the introduction of elementary physiology into the lowest grade of schools, but urged that, instead of beginning in the fifth grade, the nervous system should have a place in the first. The very difficulty of the subject demanded that its rudiments be acquired early. Paradoxical as it sounds, the brain, as a gross object, is easier to study than the heart. He would have the sheep's brain put into the hands of the youngest scholars to draw and observe. At later stages comparison should be made with the brains of cats and dogs, and, still later, the general plan of the vertebrate brain should be elucidated upon that of the green turtle. In every high school should be at least one well-preserved human brain and a series illustrating the development of the organ. From scholars thus early and gradually familiarized with fundamental facts and ideas much might be expected in universities and medical schools.

Mrs. S. H. Gage, of Ithaca, spoke of the desirability of keeping the minds of the children pure by telling them the truth about their own origin and development.

Professor John F. Woodhull, of New York, in view of some of the criticisms of

* Delivered at the meeting of the American Society of Naturalists, December, 1887; printed in the *American Naturalist*, September and October, 1888. Published by D. C. Heath & Co.

science work in the State, contended that poor work in science is better than none at all. If we are ever to have good science teaching we must first *begin*.

There have been many sins committed under the head of 'teaching observation.' We are learning that one may be a very good observer in lines in which he is interested, but very unobservant in other lines. We must not expect more of the children than of ourselves. Observation is only good when you have some use for it, when you are looking for something to relate to something else. This is scientific observation.

Dr. Frank Baker, of the University of Georgetown and Superintendent of the National Zoological Park in Washington, remarked that the teaching of science in the schools of Washington, D. C., begins in the low grades, children being taught to observe common objects of biological interest, note their parts and describe them. They are often taken out upon excursions into the country to observe the geological formations, the plants and the animals. The Zoological Park, free to the public, is much used for this purpose. He also remarked upon the ethical bearings of science teaching.

Dr. Herbert Williams, of the University of Buffalo, was one of the few representatives of the medical schools of the State who were present. He thought that teachers in medical schools might have attended these meetings with much profit. Too little thought is given to *methods* of teaching, even in medical schools of the highest standing. He was delighted with the prominence given to laboratory work. Medical schools are constantly giving more time and increasing facilities to laboratory work. But, after all, this can include only a part of the field to be covered. The pupil can verify some of the facts given him to study, but the major part must still be learned outright and taken for granted. Yet laboratory work covering part of the ground studied gives a more concrete idea of the whole and makes the student feel more certain of the realness of what he learns second hand.

He was astonished that no one else seemed to have met with the difficulty that he had felt most keenly. Though he had the necessary laboratory equipment and an earnest, intelligent class of students, he found it very difficult to teach the large numbers that came to him—twenty-five to fifty at a time. Even with the help of two or three assistants he found it impossible to assure himself that every one of his pupils saw things correctly with the microscope and appreciated what he was looking at. Suppose a class is studying the amœba. The practical difficulties of showing the amœba to each of fifty students are great. If they are beginners you may use up an afternoon in finding amœbas for each of fifty students and in distinguishing them from air bubbles, bits of dirt, and all the innumerable living things seen in stagnant water, to say nothing of having your students interpret the object correctly after they have found it.

More time is needed for science work, and smaller classes, and he believed medical schools were trying to teach their students too much, but at present the situation must be met as practically as possible. The conditions in the high schools must often be very much the same in these respects as in the medical colleges, and it is surprising that high school teachers have not been more impressed with these difficulties.

Dr. Charles J. Walch, of Syracuse, spoke of the successful work in nature study in the Syracuse kindergartens, where the children study in their own gardens the development and growth of different plants. He warmly endorsed Mrs. Gage's sentiments.

Professor George F. Atkinson, of Cornell, thought that the outline for the study of zoology as presented in the Regents' Bulletin offered encouragement for the presentation of a much better course of study in this subject than was the case with botany.

With a few exceptions the study of botany in the high school is merely the study of the various members of the higher plants with the sole view of using this knowledge in 'running down' the plant to its name. This method of study has brought the science of botany into disrepute in many quarters. If we should study zoology in a similar way we might confine ourselves to the birds and study the various kinds of feathers, the modifications of the beak, toes, etc., with the sole purpose of using the knowledge of these things to trace, with the aid of a key, the bird to its name. No one would call such work zoology. No more is the similar method employed by many in dealing with plants botany, and yet in many places the word botany suggests that kind of study alone. It has sometimes seemed to the speaker that if it were possible to drop the word botany we might at the same time do away with certain prejudices against the study of plants; and if we should instead use the word *phytology* the study of plants would thus be placed among 'ologies,' and would at once, from the very name, be recognized as a science!

Regarding the study of types it was suggested that no plant is a type of a branch or class of plants, and that the study of several plants in a class would give a better knowledge of the characteristics of the class than the study of a single one. The study of a single plant or animal to represent a large group may be carried too far in the case of beginning students. By going deeply into the minute structure of a single plant or animal a mass of facts is obtained, which may be very interesting and wonderful, but which do not in themselves teach any great principle. It would be better for the young student to study the plant or animal less thoroughly and to study others of the same class in comparison.

Emphasis was laid on the importance of so conducting elementary science study as to bring frequent deductions of some fundamental law or principle from the few facts observed. Training in such methods of study, the comprehension of fundamental principles, and the tying together of the facts observed into a living whole, gives far greater power than the mere observation of many wonderful details of a few organisms.

Principal S. G. Harris, of Baldwinsville, seconded the ideas of the preceding speaker on the inductive method in biology. In the grades this method may be used to advantage in order to foster a love of nature and prepare the pupil for the work of the high school. By skillful questions and suggestions the teacher leads her pupils to see the facts of one form and another in nature about them. Frequent repetition of this operation fixes the habit; so that when the pupils reach the high school they have not only a habit of observation and a love for the study, but also the pegs on which they may hang subsequent knowledge—apperceptive centers about which new facts may be grouped. Then, and not till then, are they prepared intensively to study any living form, singly or comparatively.

No wonder some pupils do not take to the study of science in high school or college, if they must begin by mastering classification, technical terms and a sea of facts, without either a desire for the facts, a habit of seeing for themselves or a single fact by which to fasten their knowledge. Too often teachers seem to think than one must have the knowledge of a specialist to rightly teach pupils in these studies, so great is the field. Here is the danger, not that the teacher may know too much, but that she may *tell too much*. The idea is to

direct thought as induced by the object studied, not to pour into the young mind thoughts of others. There is no surer way of disgusting a child with nature than to give him laws and technical terms that are beyond his years.

Dr. Amelia Earle Trant, of the Buffalo high school, spoke from the standpoint of a high school teacher of physiology working under conditions not altogether favorable, such as large classes, and pupils with no previous knowledge of chemistry or physics. While thorough scientific work here is perhaps impossible, there are, however, certain definite results obtainable which are not only valuable and practicable, but also consoling and, on a broad outlook, satisfactory. She must be satisfied to ignore the meagre amount of technical physiology possible to be taught under such conditions, if a few things in English and ethics can be mastered.

For instance, she would be satisfied if the definition of physiology is so clearly understood that the word may be used interchangeably with its synonyms, use, function, action or office; if the distinction between the terms physiology, anatomy and hygiene is clear beyond question; if the vital, practical import of personal hygiene and of public sanitation is too firmly impressed to be forgotten; if the difference between vivisection and dissection is clear enough for missionary work in the household—information as to the value, the necessity and the place of each being so much needed in these days of sensational head lines; if the etiquette of class demonstration, is acquired, so that all material is regarded with appreciative interest rather than with amusement, flippancy or pseudo-disgust; if reverence for the wonder and the mystery of created things is so increased that the pupil's attitude of kindness could but be approved by the Humane Society; if a little lesson in broad-mindedness is learned and the Ainsworth Law found not to be the whole of alcohol; if interest has been aroused—even if the majority of boys, and girls as well, decide with the iridescent imagination of youth that they will be physicians; if the knowledge of physiological problems yet to solve will be likely to make simple reading of scientific discoveries interesting in the days to come; if at the end of the term most of the pupils are able to hold their own in a test from the outside, questions reasonable and broad, such as the Regents' examinations have been of late; and finally she is satisfied if, when leaving the subject, the pupils take with them its most important lesson of life—that the physiological axiom, "The well being of the whole depends upon the integrity of the unit," is also a great ethical truth, inexorable not only in the human organism, but also in the school, the family, the State and the Nation.

The other speakers were Professor H. J. Schmitz, of Geneseo Normal, and Dr. Frank McMurry, of Buffalo School of Pedagogy.

The convention closed with a business meeting Thursday afternoon. A number of changes were made in the constitution. It was decided to have a committee of nine members appointed by the President to report to the Association at its next annual meeting on the following subjects: (1) The recognition of science as a requirement for entrance to colleges. (2) Science courses for secondary schools. (3) Nature study in elementary schools.

The following officers were elected for the year 1897. The presidency was offered to Professor Gage for another year, but at his earnest request, another was nominated in his stead.

President, Dr. E. L. Nichols, Cornell University; Vice-President, Dr. Charles W. Hargitt, Syracuse University; Secretary and Treasurer, Dr. Franklin W. Barrows, Buffalo High School.

Executive Council. Four years—Dr. Charles W. Dodge, University of Rochester; Principal Henry Pease, Medina High School; Professor W. C. Peckham, Adelphi College, Brooklyn. Three years—Dr. J. McKeen Cattell, Columbia University, New York; Professor LeRoy C. Cooley, Vassar College, Poughkeepsie; Professor E. R. Whitney, Binghamton High School. Two years—Professor Irving P. Bishop, Buffalo Normal School; Mr. Charles N. Cobb, Regents' Office, Albany; Professor C. S. Prosser, Union University, Schenectady. One year—Professor Albert L. Arey, Rochester Free Academy; Professor R. E. Dodge, Teachers' College, New York; Professor T. B. Stowell, Potsdam Normal School.

FRANKLIN W. BARROWS,
Secretary.

MIGRATION OF BATS ON CAPE COD, MASSACHUSETTS.

BAT migration has received little attention. Various writers have made vague reference to the fact that certain bats are found in winter at localities where they are not known to breed, but no detailed account of the migratory movements of any species has yet been published. The only special paper on the subject that I have seen is by Dr. C. Hart Merriam,* who clearly establishes the fact that two North American bats migrate. The data on which this conclusion rests are as follows: The hoary bat, one of the migratory species, is not known to breed south of the Canadian fauna. In the Adirondack region it appears about the middle of May and disappears early in October. During the autumn and winter it has been taken in South Carolina (Georgetown, January 19th), Georgia (Savannah, February 6th), and on the Bermudas† ('autumn'). As the writer remarks, these facts may be fairly regarded as conclusive evidence of migration. The evidence of the migratory habits of the silver-haired bat rests chiefly on the animal's periodical appearance in spring and fall at the lighthouse on Mount Desert Rock, thirty miles off the coast of Maine. This species has also been observed on the Bermudas.

In August and September, 1890 and 1891, I had the opportunity to watch the appearance and disappearance of three species of bats at a locality where none could be found during the breeding season. Highland Light, the place where my observations were made, is situated near the edge of one of the highest points in the series of steep bluffs of glacial deposit which form the outer side of Cape Cod, Massachusetts. The light, which is less than ten miles from the northern extremity of the cape, is separated from the mainland toward the east and northeast by from twenty-five to fifty miles of water. The bluff on which it stands rises abruptly from the beach to a height of one hundred and fifty feet. I found the bats for the most part flying along the face of this bluff, where they fed on the myriads of insects blown there by the prevailing southwest winds. They chiefly frequented the middle and upper heights and seldom flew over the beach at the foot of the bluff or over the level ground about the lighthouse. I do not know where the animals spent the day, as careful search in old buildings, under the overhanging edge of the bluff, and in deserted bank swallow holes, failed to reveal their hiding places. It is possible that they found shelter in the dense, stunted, oak scrub with which the bluff is in many places crowned, but of this I have no evidence. I hope that the observations given below may again call the attention of field naturalists to a subject which presents many difficult and interesting problems.

ATALAPHA NOVEBORACENSIS* (RED BAT).

August 21, 1890. The first bats of the season were seen this evening. There were

*Trans. Royal Soc. Canada V (1887), Section V, p. 85, 1888.

† I may add that I have a bat of this species, killed at Brownsville, Texas, on October 22d.

*With bat nomenclature in its present unsettled state it is well to use the names adopted by Dr.

only two, and I could not positively identify them, but they were probably red bats.

August 25, 1890. An adult male taken.

August 28, 1890. Two seen.

August 29, 1890. The evening was too chilly for many bats to be on the wing. A few *A. noveboracensis* seen and two taken.

August 30, 1890. Six or eight *A. noveboracensis* seen and three taken. The evening was warm and bats flew much more freely than on the 29th.

August 31, 1890. A chilly evening again, and only two bats seen, both *A. noveboracensis.*

September 2, 1890. A few red bats seen and two taken.

September 5, 1890. I was not at Highland Light this evening, but Mr. W. M. Small reported a heavy flight of bats. He shot five, all *A. noveboracensis.*

September 8, 1890. Heavy fog, so that no bats could be seen, if any were moving along the face of the bluff. Three or four red bats flew about the light house tower during the first half of the night, feeding on insects attracted by the light. They flew mostly below the level of the deck which encircles the tower about six feet below the lantern and never approached the light itself.

September 12, 1890. A single red bat shot this evening.

After this date I watched for bats on several consecutive evenings. As I saw no more I concluded that the migration had ended.

August 25, 1891. Fourteen *Atalapha noveboracensis*, the first bats of the season, seen this evening. They were flying both north and south.

August 26, 1891. Evening very foggy. A red bat which flew about the lighthouse was the only one seen.

Harrison Allen in his latest Monograph of the Bats of North America (1893), although many of these will require revision.

August 27, 1891. Half a dozen red bats seen and one taken.

August 28, 1891. Four red bats seen. All flew toward the south.

August 30, 1891. A red bat caught in a house near the edge of the bluff.

September 2, 1891. Eight or ten seen and three taken. The movement this evening was mostly, though not wholly, from north to south.

September 3, 1891. Six seen and three taken.

September 5, 1891. Evening cold and misty. No bats moving.

September 7 and 8, 1891. A few bats seen each evening, but none taken. All appeared to be this species.

September 10, 1891. One red bat shot.

September 11, 1891. One seen.

September 12, 1891. One killed. About a dozen bats seen, but how many were of this species, and how many *Lasionycteris noctivagans* I could not determine.

September 13, 1891. About a dozen bats seen. Two of these were certainly red bats.

After this date I watched for bats on consecutive evenings for more than a week. As I saw none I finally gave up the search.

ATALAPHA CINEREA (HOARY BAT).

August 26, 1890. One *Atalapha cinerea*, the only bat seen, shot this evening.

August 28, 1890. Two hoary bats taken, and at least two, and probably four, others seen.

August 30, 1890. Two taken and two others seen.

September 2, 1890. Only two seen. Both taken.

No more hoary bats seen during 1890.

August 25, 1891. A single *Atalapha cinerea* seen flying south along the face of the bluff this evening.

September 2, 1891. One seen flying north.

September 12, 1891. An adult male shot—the last of the season.

At Highland Light I found the hoary bat less active and irregular in its movements than the red bat. Its large and comparatively steady flight made it easier to shoot than either of the two smaller species with which it was associated. It began to fly immediately after sunset. In the Adirondacks Dr. C. Hart Merriam found the hoary bat a late flyer, and an exceeding difficult animal to kill on account of its swift, irregular motions.* It is possible that while on Cape Cod the animal modifies its habits on account of the unusual surroundings in which it finds itself. The fatigue of a long migration might also have an appreciable effect on a bat's activity.

LASIONYCTERIS NOCTIVAGANS (SILVER-HAIRED BAT).

September 1, 1890. One silver-haired bat taken.

September 2, 1890. Four taken and perhaps a dozen others seen.

The silver-haired bat was not seen again during 1890.

September 10, 1891. Three shot and probably half a dozen others seen. They were mostly flying north.

September 11, 1891. Two shot and four or five more seen.

September 12, 1891. About a dozen bats seen. Some were without doubt this species, but just what proportion I could not tell.

While September 12th is the latest date at which I have seen *Lasionycteris noctivagans* at Highland Light, I have a specimen killed there by Mr. W. M. Small on October 28, 1889.

GERRIT S. MILLER, JR.

ZOOLOGICAL NOTES.

MUSEUMS AND SCIENCE.

THE recently published report of the 1896 meeting of the Museums Association of Great Britain shows how much interest is taken and thought bestowed in rendering museums instructive and attractive to the public. The most interesting of the eleven papers read, however, is one from the sharp-pointed pen of Mr. F. A. Bather, dealing with the scientific rather than the popular side of museums, and entitled 'How May Museums Best Retard the Advance of Science?' Chief among these is "that jealousy with which a museum curator should guard the precious specimens entrusted to his care, forbidding the profane hands of the mere anatomist ever to disturb them in their holy rest." This is a well-aimed shaft, for specimens have no value save for the information to be extracted from them, and yet, in too many cases, they are regarded as fetishes and, like *Spirula* and *Notoryctes*, carefully bottled up with the probability that they will eventually go to pieces without yielding up any information. Another point on which Mr. Bather dwells at some length is the "idea of keeping certain collections separate according as they happen to have belonged to some person with a lengthy name * * * or to have been presented by some individual who laid it down in his will that his specimens were to be known for all eternity as the 'Peter Smith Collection.'" This is a matter that was touched on by Dr. Goode in his principles of Museum Administration, and, as he says, "the acceptance of any collection, no matter how important, encumbered by conditions, is a serious matter, since no one can forsee how much these conditions may interfere with the future development of the museum." Fortunately, the bequests received by the larger museums of the United States are practically unhampered. Other methods of impeding the progress of science are noticed, such as striking dullness through the hearts of thousands by funeral rows of stuffed birds with their melancholy Latin names, and, as Mr. Bather says, much may be done if a museum will keep its material carefully to itself. On the question of

* Trans. Linn. Soc. New York, II, p. 78–83. 1884.

loaning specimens Mr. Bather dwells lightly, owing to his connection with the British Museum, whose policy in this respect is well known. Here, again, we in this country are fortunate, as most specimens, even types, may be borrowed by workers in museums and some knotty problems thereby unravelled, but the main propositions in the paper demand a careful consideration. Finally, Mr. Bather seems to use the term type a little vaguely, as one does not feel quite sure whether he means type or typical material. There can be but one type, or one series of specimens collectively forming a type, and no museum can afford to permanently part with these. Typical specimens are quite another matter, and the more distributed the better.

A DOG OF THE ANCIENT PUEBLOS.

Among the many objects obtained by Dr. Fewkes last summer from the ruined pueblo of Chaves Pass, Arizona, is the cranium of a domesticated dog, found in a grave with a human skeleton. Although the mere fact of a dog being discovered under such circumstances is in itself interesting, it is not at first sight remarkable, since it is well known that in America, as elsewhere, the dog was domesticated at an early date, and Clavijero mentions an ancient dog which he calls "a quadruped of the country of Cibola, similar in form to a mastiff, which the Indians employ to carry burdens." Aside from the fact that this is the first dog's cranium discovered by Dr. Fewkes, there are some points of special interest in the present case. Most of the Indian dogs are more or less wolfish in their aspect, and have long skulls with comparatively low foreheads, thus showing a small degree of specialization in the way of breed, and this is true of such of the mummied dogs of Egypt as I have seen. The cranium of the Chaves dog, on the contrary, is of the broad-faced type, with high forehead, and, curiously enough, is precisely similar in size and proportions to the cranium of an Eskimo dog from Cumberland Sound, the resemblance extending to the peculiar concavity and squareness of the nasal region. While this is an interesting coincidence, it is not brought forward as implying community of origin, but as instancing long domestication in order that so well-marked a breed could be established. A curious confirmation of the early origin of this breed was received from San Marcos, Texas, where, in excavating for ponds, at the station of the U. S. Fish Commission, a human skeleton and bones of other animals were found in a layer containing many flint implements, overlaid by two feet of black soil. The bones were those of existing species, including teeth of several bison, and there was also a fragment of a dog's skull similar in size and proportions to that obtained at Chaves Pass. Owing to the circumstances under which the bones were exhumed it is not known whether or not the dog and man were found together. While none of the bones were mineralized, the condition under which they were found, and the character of the human cranium, showed them to be of very considerable age.

Dr. Fewkes states that the skulls of carnivores are used in Hopi religious ceremonies and that the skull, paws, etc., are regarded as powerful fetishes of warriors and cherished by them with much care. It is customary to bury a priests' fetishes with him, and there is little doubt that the dog's cranium from Chaves Pass was a fetish of the man in whose grave it was found. As Dr. Fewkes believes that the people of the Chaves Pass ruin formerly lived far south, in contact with Nahuatl peoples, it can readily be seen how a dog's skull came to be part of the ceremonial outfit of the priest in whose grave it was found.

F. A. Lucas.

U. S. National Museum.

CURRENT NOTES ON ANTHROPOLOGY.

EUROPEAN ETHNOGRAPHICAL MUSEUMS.

A VERY useful report on the ethnological museums of central Europe has been published by the Dutch Ministry of the Interior, from the studies of Dr. J. D. E. Schmeltz (Ethnographische Musea in Midden-Europa, E. J. Brill, Leiden, 4to. pp. 109).

It contains the observations made during his personal visits to all the great collections of Berlin, Vienna, Munich, Paris, London, etc., in the summer of 1895. Many of the more interesting objects are described and figured, and both the contents of the Museums, their arrangements for display and their architectural plans are discussed. Dr. Schmeltz is thoroughly conversant with the literature of modern ethnography, and his numerous references to monographs and special articles are a fruitful lesson in themselves. There is an excellent index, in which I note that 'America' includes objects in twenty of the collections visited.

ETHNOGRAPHICAL SURVEY OF GREAT BRITAIN.

THE fourth report of the committee of the British Association which has this survey in charge has been published. It is of exceptionable interest, its leading feature being an article by Mr. G. Lawrence Gomme, on the method of determining the value of folk-lore as ethnological data. In this he explains the principles of the classification and analysis of the facts gleaned by folk-lore researches, and illustrates the scientific method of handling them by a a discussion of the fire rites and ceremonies retained among the rural population of the United Kingdom. The conclusions he reaches are valuable, both in themselves and as a fine exemplification of the correct plan of utilizing such material to enlighten us as to early considerations of social life, concerning which history tells little or nothing.

The general report is drawn up by the Chairman, Mr. E. W. Brabrook, and is accompanied by notes from the Secretary, Mr. E. Sidney Hartland.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

M. BERTHELOT has recently published in the Comptes Rendus analyses of weapons, tools, etc., from Tello, in Chaldea. Their date is put from 4000 to 3000 B. C. A large lance and a hatchet were found to be approximately pure copper, and another hatchet was of copper with traces of arsenic and phosphorus, by which it seems to have been hardened. No trace of tin was present in any case. Thus in Chaldea an 'age of copper' seems to have preceded the 'age of bronze.' An egg-shaped object from the same locality, weighing 121 grains, was of iron; an ingot of white metal was 95 per cent. silver; a leaf of yellow gold was found to contain considerable quantities of silver.

THE following order appears in the English scientific journals: "In consequence of the growing importance of carbid of calcium, and the fact that the mere contact of moisture with this material causes a dangerous evolution of the highly inflammable gas known as acetylene, the Home Secretary has caused inquiries to be made into the subject, with the result that an Order in Council has to-day been made under the 14th section of the 'Petroleum Act, 1871,' bringing carbid of calcium within the operation of that Act. Accordingly, from the date on which such order comes into force, viz., 1st April, 1897, it will be unlawful to keep carbid of calcium, except in virtue of a license to be obtained from the local authority under the Petroleum Act."

THE Council of the Chemical Society (London) have awarded the Longstaff medal to Professor William Ramsay, F. R. S.,

for the discovery of helium and his share in the investigation of argon.

The last Proceedings of the Chemical Society contain a further study in spectrographic analysis by W. N. Hartley and H. Ramage. The alums are found to contain *all* the alkalies as well as copper, silver, gallium, thallium, nickel and manganese. Of these the thallium comes from the pyrites, but the other elements from the aluminous minerals, bauxite and shale. The Stassfurt minerals were found to contain no rubidium, cesium, gallium or thallium, and only barest traces of elements other than the principal ones composing the minerals. Steel (from Middlesborough) contained the alkali metals, calcium, copper, silver, gallium, manganese and lead. It is pointed out that this method of spectrographic analysis might lead to results of practical importance in the study of railroad steels, as copper, (?) silver, gallium and lead have not been considered in dealing with commercial irons, and their influence upon the physical properties is unknown.

The *Gazzetta Chimica Italiana* contains an article by U. Antony and T. Benelli on the action of water of various degrees of purity on lead pipes. The greatest solvent action was in the case of distilled water, especially when saturated with air. Aeration with carbon dioxid retarded the action one-half. Water containing calcium sulfate or sodium sulfate possesses about one-half the solvent power of pure water, and the action here also was much retarded by aeration with carbon dioxid. Bicarbonate of lime had only about one-fourth the solvent power of pure water, but when aerated by carbon dioxid its action was nearly doubled. Common salt had little action except in the presence of carbon dioxid, and seemed to often slightly diminish the solvent powers of other salts. These results are rather at variance with the generally accepted ideas and seem to show that waters with permanent hardness would be seriously contaminated by passage through lead pipes and ordinary hard waters only somewhat less so. The maximum amount of lead dissolved was 130 parts per million, for five days contact of 150 ccm. ordinary distilled water with 285 sq. cm. lead; the minimum 6.8 parts per million for water containing sodium chlorid and aerated with air.

In the same number of the *Gazzetta* Professors Antony and A. Lucchesi describe the reaction of an excess of mercurous chlorid on auric chlorid with the production of the characteristic color of purple of Cassius. Similar results are obtained with cuprous chlorid and the chlorid of gold. When barium sulfate and mercurous chlorid are suspended in water and auric chlorid added, the barium sulfate takes up the gold and becomes the color of the purple of Cassius. From these experiments the authors conclude that the true purple of Cassius is not a definite compound, but merely stannic acid mechanically colored with metallic gold. J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE THREATENED LEGISLATION AGAINST SCIENCE AND EDUCATION.

The Ways and Means Committee of the House, either convinced by argument or coerced by the force of public opinion, has retracted the duty on scientific apparatus and books imported for institutions in cases in which the apparatus and books are not manufactured in the United States. It is satisfactory to find that the committee is willing to reconsider its ill-advised action, even though it has but partially corrected its blunders. The provision imposing a duty on instruments and books also manufactured in the United States is ambiguous and will cause endless confusion. If the Encyclopædia Britannica is pirated in America will that prevent its importation for a library? If a microscope is manufactured in America will that prevent the importation of all instruments

called microscopes? Mr. Dingley has stated for publication that his objection to exceptions in the tariff is the trouble they cause custom house officials, but he appears now to propose exceptions that can only be defined by the Courts.

We asked the leading makers of scientific instruments in the United States whether they regarded a tax on instruments imported for educational institutions as likely to be beneficial or harmful to them. The answers were about equally divided. One maker writes: "We know that putting these on the free list ruined our business in that line." Consequently his business must have been ruined in the eighteenth century. Half of those who favor the duty had not heard of its proposal, and it thus seems that it was not planned in consultation with those interested. If Mr. Dingley had consulted makers of instruments he would have found opposition to his plan. Thus Messrs. Warner and Swasey write us: "We believe that all institutions of learning should be able to purchase their instrumental equipment in the cheapest market, and that thereby the good of all will best be secured. We would, therefore, be loathe to have any duty imposed that would interfere with the best results of our schools and colleges, as we fear would be the case should the proposed duty come into effect." Mr. John A. Brashear states that he is making more instruments for foreign than for home universities.

We feel sure that our legislators at Washington wish to do the best they can for the country and for themselves. If it be brought to their attention that books and instruments are the raw materials of science, education and civilization they will not wish to tax these. When they see that the leading Republican papers, such as the New York *Tribune*, the Boston *Transcript* and the New York *Independent*, oppose such legislation, they will not wish to carry its burden through the elections of 1898 and 1900.

GENERAL.

PROFESSOR W. W. HENDRICKSON, head of the department of mathematics at the Naval Academy at Annapolis, has been appointed Superintendent of the American Ephemeris and Nautical Almanac, in succession to Professor Simon Newcomb. The retirement of Professor Newcomb, on reaching the age limit fixed by the naval authorities, has called forth many notices in appreciation of his great contributions to science.

THE American Mathematical Society will hold its summer meeting at Toronto on Monday and Tuesday, August 16th and 17th. It will thus follow the meeting of the American Association for the Advancement of Science at Detroit, and precede the meeting of the British Association at Toronto.

As we have already announced, the Fourth Triennial Congress of American Physicians and Surgeons will be held at Washington on May 4th, 5th and 6th. The sessions of the societies will be held in various places, the American Physiological Society and the American Anatomists having been assigned rooms in the Columbian University. The President of the Congress, Professor William H. Welch, of Johns Hopkins University, will deliver an address on Wednesday evening, May 5th, at 8.15 o'clock, in the Columbia Theatre. The exercises attending the unveiling of the statue of Professor Gross, under the auspices of the Surgical Association, will be held on Wednesday, May 5th, at 5 o'clock. The Executive Committee has decided that the Congress shall give a dinner on Tuesday evening, May 4th, at the Arlington, to which guests will be invited. On Wednesday evening, at 9.30 o'clock, the President of the Congress will receive the members, the invited guests and the accredited visitors, with the ladies accompanying them, at the Arlington. On Thursday evening the Cosmos Club will give a complimentary 'smoker' to the Congress.

THE Sinking Fund Commissioners of the City of New York upon March 25th unanimously adopted a resolution setting aside the entire southern portion of Bronx Park, comprising 261 acres, for the establishment of a Zoological Park. The tract is directly in the geographical center of the great 'annexed district.' The conditions are that the Society shall raise $100,000 before entering the tract, and an additional $150,000 within three years

from the date that the work of improvement of the land is begun by the Park Department. The Society will contribute the buildings and collections of animals. The city will expend $125,000 immediately in the preparation of the land, and will during the first year of occupation provide a maintenance fund—not exceeding $60,000—for the care of the animals and further improvement of the park. In a coming issue of SCIENCE a full account of the plans of the Society will be published.

THE Missouri Legislature has made the usual biennial appropriation of $30,000 for the support of the State Geological Survey. In Iowa the law governing the Survey has been incorporated in the new code, thus assuring the permanence o the work. In both States the bills passed without opposition of note.

THE sixty-ninth meeting of German Men of Science and Physicians will be held at Brunswick from the 20th to the 25th of September of the present year. There will be thirty-three sections as compared with thirty at the Frankfort meeting. The new sections are anthropology and ethnology, which at Frankfort was united with geography, geodesy and cartography and scientific photography.

THE scientific work which is such a prominent part of the manufacturing chemical establishments of Germany is again borne witness to by the fact that the firm of Friedrich Bayer & Co., manufacturers of dye stuffs in Elberfeld, has purchased the library of the late Professor Kekulé, consisting of 18,000 volumes, and said to be the most complete collection of chemical works in existence.

FROM the plans submitted in the competition for a statue of von Helmholtz, those by the sculptors Lessing, Hertert and Janenseh have been selected and exhibited in Berlin. The final selection has not yet been announced. The statue will be placed in the court of the University near the statues of the two Humboldts.

A COMPANY has been organized in Berlin for the establishment of a German colonial museum.

IT is reported that Dr. Nansen will lend the Fram, the vessel in which he made his Arctic journey, to a private Arctic expedition that will start during the coming summer. The expedition will be mainly English, and its purpose will be meteorological observations and an examination of the Arctic currents.

MR. CHARLES ELIOT died at Brookline, Mass., on March 25th, at the age of thirty-seven years. Mr. Eliot was the landscape architect of the Boston Metropolitan Park Commission. The admirable park system of Boston and the preservation of public reservations throughout the State are largely due to his influence.

WE regret to note the deaths of Dr. Kolbe, professor of mathematics in the Polytechnic Institute at Vienna, at the age of seventy-one years, and of Dr. Wilhelm Doellen, the astronomer, in Dorpat, aged seventy-seven years.

A PUBLIC meeting to promote the National Jenner Memorial was to have been held in the theatre of the University of London on March 31st. It was expected that the chair would be taken by the Duke of Westminster and that addresses would be made by Lord Herschel, Lord Playfair, Lord Lister and Professor Foster.

DR. RUDOLF KOBERT, professor of medicine in the University at Dorpat, has resigned to take charge of the hospital for consumptives in Gorbersdorf, in Silesia. It is said that the Russian authorities do not wish to retain German professors in Dorpat.

THE mortality figures for the four weeks ending March 12th, at Bombay, are as follows, in chronological order: Deaths from all causes, 1,772, 1,525, 1,370, 1,274; deaths from plague, 843, 730, 635, 521. The plague shows a tendency to spread and deaths are reported from many places, including for the week 206 in Karachi.

ACCORDING to the *Bulletin of the American Mathematical Society*, Professor O. Schlömilch, the founder of the *Zeitschrift für Mathematik und Physik*, has withdrawn from the editorship of this journal, which he has conducted for 41 years. Dr. R. Mehmke, professor of mathematics in the Polytechnic School at Stuttgart, takes his place, while Professor M. Cantor, of the University of Heidelberg, will continue to have charge of the 'literarisch historische Abteilung.'

THE students of Stanford University have be-

gun the publication of an *Engineering Journal*, which will be issued semi-annually. The first number opens with an article by F. A. C. Perrine, entitled 'A Practical Index of Engineering Literature,' which is followed by several other articles showing the high character of the work in engineering accomplished in Stanford University.

A MONTHLY journal entitled *Deutscher Tierfreund* has been established in Leipzig under the editorship of Dr. R. Klee.

THE first edition of the New York State botanist's report on 'Poisonous and Edible Fungi' has proved insufficient to supply the demand, so that it will be impossible to fill further orders for the work unless a new edition is printed.

DR. HENRY E. ARMSTRONG has prepared an extended article now being published in successive numbers of *Nature* entitled 'The Need of Organizing Scientific Opinion.' The article is a severe arraignment of the lack of scientific principles and research in British manufactures and of English educational methods as compared with those of Germany. Dr. Armstrong writes of the United States as follows: "America is bound, in fact, to develop, and not only on account of the restless energy of her people; her Government departments have attached to them many active men engaged in initiating or conducting scientific inquiries; and when the various departments are organized *inter se* the country will have in its service a highly-trained body of scientific experts guiding all branches of public work and cooperating to minimize the faults of democracy. And universities are arising all over the country, in which German models are being followed, not English. It is safe to predict that, ere many years are past, the United States will suddenly burst into prominence, and probably into predominance, as a nation promoting scientific inquiries of all kinds, so surely is a foundation being laid. Mistakes will frequently be made, perhaps, but they will soon be recognized and remedied in a country instinct with advance."

THE *Engineering News* states that a textile school has been established in Lowell, Mass. The city appropriated $25,000 for its support, and the manufacturing establishments contributed $50,000 in machinery and other facilities. The equipment is said to compare favorably with that of similar schools in England and on the Continent, where they have been maintained for a number of years and are constantly growing in number. It is stated that the competition of Southern mills in the production of ordinary grades of cotton goods has led the Lowell manufacturers to turn their attention to the finer grades, which have hitherto generally been imported from Europe, where the textile schools have been of great aid in training skilled workmen and designers.

SIR DOUGLAS GALTON has issued an appeal for subscriptions to the Childhood Society, which has recently issued a report on the scientific study of the mental and physical conditions of childhood, giving details of 100,000 children, examined individually. It is estimated that the sum of £1,000 would be needed to examine 50,000 children in twenty-five towns.

UNIVERSITY AND EDUCATIONAL NEWS.

HAVERFORD COLLEGE has now received the title deeds to the real estate of the late Jacob P. Jones, of Philadelphia, who in 1885 made the College his residuary legatee. The estate is valued at $900,000. Haverford College, which is located near Philadelphia and is conducted under Quaker auspices, is now one of the best endowed of our colleges. The trustees have wisely decided to maintain a strong college and not to attempt the development of a university.

THE long contested Marett will case has been decided by the Supreme Court of Connecticut, giving, among other public bequests, $18,000 to Yale University.

IT is reported in the daily papers that the late Mr. Deury, said to be a multi-millionaire and the largest landowner in the United States, has left his estate to his widow for life and at her death ninety-one hundredths of it for the establishment of a college in Illinois.

BILLS have been reported favorably in the New York Legislature authorizing New York City to spend $12,500,000 in school buildings.

DR. JULIAN APRICIO has been appointed Director of the Meteorological and Astronomical

Observatory of San Salvador. Dr. Szymonowicz, of the University of Cracow, has been made associate professor of histology and embryology in the University of Lemberg.

DISCUSSION AND CORRESPONDENCE.

RELATIONS OF TARSIUS TO THE LEMURS AND APES.

UNDER this title Mr. Charles Earle, in your issue of February 12, 1897, gives a valuable contribution to our knowledge of the mutual relationship of recent and fossil Lemurs and discusses at the same time a proposal made by myself to remove Tarsius from among the Lemurs and to place it with the Primates *s. str.*

Such proposal finds but scanty favor in the eyes of this able paleontologist, who formulates the *a priori* objection that "we shall be little benefited by this change in the classification of the Primates, as it will be exceedingly difficult to discover any characters of the skeleton by which we can separate the Apes from the Lemurs."

Now, I hold that the primary object of classification is not to facilitate or to benefit, but to establish, as closely as possible, the true position which species and genera, both living and fossil, occupy in the actual line of descent, which is slowly but surely revealing itself to the persistent and combined efforts of paleontology, anatomy and embryology.

At the same time, if Mr. Earle finds fault with the embryologist who wishes to transfer Tarsius from the Lemurs to the Apes, he is fully entitled to stand by his osteological and dentary characters and to fight for the current classification, that is apparently more convenient to paleontologists. He is, however, bound to state the arguments of his opponent fully and fairly, and this he does not do when he suggests to his readers that my reason for removing Tarsius from the Lemurs lies in its different 'type of placenta,' nor is he quite up to date in his valuation of recent placental investigations when he complacently quotes Mivart's and Balfour's warnings against the systematic value of differences in placental arrangements, when not accompanied by other characteristic differences.

It is, indeed, rather hard upon me, who have endeavored, in the past eight years, to clear up some of the confusing views that were being entertained concerning placentation in general, to be now pilloried by Mr. Earle as if *I* had been making that coarse and indiscriminate use of placentary characters in classification against which I have been all the time loudly protesting. Thus, for instance, I have shown that the placenta of the hedgehog, the shrew and the mole is in each case a structure *Sui generis*, all these different Insectivores having placentas of the discoid shape, but which reveal themselves, on close and careful examination, both in their structure and in their genesis, as far more different *inter se* than is the diffuse placentation of the horse from that of the Lemurs or from the cotyledonary placentation of the Ruminants. I have hitherto refrained from proposing changes in the classification of the Insectivores, because I am well aware that to make these fruitful the paleontological and anatomical evidence tending in the same direction will first have to be collected and sifted. Nor would I dream of bringing Tarsius in closer connection with the Apes on account of the discoid placenta, for the very same reasons that it is not the external shape, but the histological and the genetic details, which are of importance in any such comparison. Still Mr. Earle would make the readers of SCIENCE believe (see p. 258) that this is my line of argument!

Referring to my paper in the *Gegenbaur Festschrift* (1896)—the abstract of which appeared in an October number of SCIENCE and can hardly have remained unknown to Mr. Earle—it will there be seen that I founded the closer relationship between Tarsius and the Apes on something quite different, viz., on the development of the embryo in a vesicle to which it does not become attached by means of an outgrowing allantois, but to which it is fixed from the beginning by a stalk of tissue ('Haftstiel' or 'Bauchstiel' of the Germans), which was up till lately only known as a characteristic feature of the human embryo, but which Selenka also discovered in monkeys (Cercocebus a. o.), and which in Tarsius has now for the first time revealed its entire developmental history, in-

cluding a very aberrant mode of formation of the mesoblast and the coelome. We are fully entitled to say that by the details of its very earliest development and of its blastocyst Tarsius is more closely related to man and the monkeys than it is to any other known mammal. And that the gulf separating Tarsius from the Lemurs on this head is far wider than that separating it from many Insectivores. This may be inconvenient for paleontologists, but none the less it remains a stubborn fact. And a fact of all the more primary importance because we must recognize that the influence of external agencies on the gradual modification of teeth and of limbs is certainly more direct than that which is brought to bear upon these very early and very hidden and intricate processes that occur inside the uterus in a most delicate vesicle that is hardly visible to the naked eye.

These few words of protest against an obvious misrepresentation may suffice. A full account both of the early development and of the placentation of Tarsius is in preparation; to this I may be allowed to refer those who might desire a fuller account of the various points above alluded to.

A. A. W. HUBRECHT.

UTRECHT, March 8, 1897.

THE JOURNAL OF SCHOOL GEOGRAPHY.

TO THE EDITOR OF SCIENCE: Professor Russell's discussion (SCIENCE, March 19) of the expediency of starting an independent *Journal of School Geography*, instead of consolidating the existing geographical journals into a single publication under the joint management of the various geographical societies in this country, affords a very pretty basis for divided opinions. To my mind there is no probability at present that the American Geographical Society, the National Geographic Society, the Appalachian Mountain Club, the Geographical Society of Philadelphia, the Geographical Society of the Pacific, and the Sierra Club of California will merge their interests and journals into a single American Journal of Geography. However attractive such an ideal may be, it does not accord with the usual run of human nature. Local and individual effort, manifested not only in the maintenance of local societies, but in the publication of more or less local journals, is likely to be the course of geographical events for many years to come.

Improvement of the existing geographical journals is probably a matter that their respective editors have warmly at heart, and I believe that they are all agreed as to the first step towards such improvement; namely, an increase in the number of geographers among their members. Several different methods may be effective in promoting this increase. The societies offer various attractive opportunities to members, in the way of libraries, lectures, excursions and so on. This promotes membership, and among increasing members it is fair to suppose that there will be an increasing number of geographers. Quite another method looks to the production of a larger crop of geographers, when the children of to-day shall reach manhood and womanhood. This method is of slow action, but, if it acts at all, it is sure. It tries to strengthen the future crop by careful cultivation of geography during school years. This is, along with other objects, one of the chief ends of the promotors of the *Journal of School Geography*. It is an end that cannot be attained by Professor Russell's plan, for the expense of such a journal as he proposes would put it entirely out of reach of schools and teachers. Moreover, in the present condition of geography and of teachers of geography in the schools of this country, there is no reason for disguising the fact that a general journal of geography, however ably edited and however well supplied with 'studies for students,' could not possibly attain the circulation among school teachers that may be attained by a special journal of school geography, directly and wholly prepared for teachers' use.

It is worth noticing that the systematic encouragement and development of geography in the schools has never been a leading feature of any geographical society in this country. The American Geographical Society, with a large membership and a rich library, has had no influence worth mentioning on the teaching of geography in the schools of New York; it has never (unless within the last year or two) tried to exert such an influence; it has been conducted with apparent entire indifference to the

development of members in the younger generation. The same is essentially true of our other geographical societies; they are not particularly concerned with the educational aspect of geography. The prizes offered to schools by one society failed of effect, for there was no substantial basis for the work that they were intended to excite. The societies are chiefly concerned with narrative reports of expeditions and excursions, and with occasional articles of more scientific and studious quality; but even the latter rarely have any effect on the schools, for they hardly ever reach the teachers. Under existing conditions, with membership in the various societies constituted as at present, it is not likely that the conduct of the societies will be materially altered. The educational element of geography will be left in the hands of educators. It will not be taken into the hands of travellers. It will not be taken up by the members who, unable to travel themselves, still enjoy hearing the narratives of returned travellers.

But an entirely additional object is also in the minds of the promoters of the *Journal of School Geography;* namely, the better education in geography of the tens of thousands of school children who will never hear anything about geographical societies; and, to this end, the better cultivation of the great body of teachers who ought in an ideal state to be students of geography, and who as such ought to be members of geographical societies, but who under existing and long enduring conditions can not be either. The great body of our teachers have had but an elementary education and have little time or inclination for study. They cannot be reached by a high-class scientific journal, such as Professor Russell contemplates, but some of them may be reached by a personally subsidized journal of low subscription price. Their work will thus be improved, and the children under them will profit thereby; but this is an end which the consolidated *American Journal of Geography* cannot hope to reach. Indeed if, under a rearranged human nature, such a journal were established, it could not have a better ally than the *Journal of School Geography.* Even as matters stand, the new journal hopes to be the means of first informing hundreds of school teachers that such institutions as geographical societies and such publications as their journals exist in this country. It is a mistake to confound the objects and fields of two publications, so essentially different.

I believe that Professor Russell is again mistaken in saying that there is nothing in the character of the new journal to indicate that it possesses greater vitality than its predecessors. One of the predecessors was a highly sensational affair, with more pretension than performance. Another was a perfectly sincere performance, but directed to a miscellaneous audience, not conducted by a teacher of school geography, and burdened with the expense of excellent illustrations. The *Journal of School Geography* has the advantage of a single, definite aim. It looks for external support to subscriptions from schools and teachers and from libraries to which teachers resort. It expects that, for a time at least, receipts from subscriptions may not equal expenses; but expenses will at the beginning be kept as low as possible by holding the pages to a minimum, and inserting illustrations only when they are paid for by the author of the illustrated article. In the management of such a journal, some might say it is best to borrow capital and begin with fine illustrations so as to catch subscriptions quickly. Others might say it is best to pay as you go. The latter plan was adopted, and I believe wisely. As soon as illustrations can be afforded, they will be introduced. At present the expenses are moderate; the subscriptions are steadily coming in; and, for one, I believe that such a *Journal of School Geography* may be made to come so near paying for itself that its life will be assured.

W. M. Davis.
Harvard University.

To the Editor of Science: Professor Russell in his letter, entitled 'A New Geographical Magazine,' in Science, March 19th, has given a chance for an expression of opinion that, as responsible editor of the publication in question, I cannot allow to pass. I question very much the suggestion that the ends sought by the *Journal of School Geography* could be better attained by a consolidation of the existing

geographical periodicals into one publication, with a department for teachers. The plan of adding such a department to an existing journal was proposed to the editors of the *Journal of School Geography* and the offer declined because they believed:

1. That the cause of geographical education warranted a separate periodical.

2. That teachers would not and could not subscribe to so expensive a journal as a valuable scientific periodical must be.

3. That educators would many of them shun pedagogic assistance vended by a society whose aims were primarily scientific.

4. That the organ of no one society or combination of societies could be advertised so as to reach the greater number of teachers.

5. That a journal *for* teachers should be edited *by* teachers.

I believe that the new journal has a legitimate right in the educational world for all these reasons and many more. The knowledge of the world may be enlarged for the few by the geographical societies, through the promotion of exploration and research and the publication of the results thereof. It may be enlarged for the many by such a journal as the one in question, if the editors sift and select new and old facts and put them in a form and dress for the larger public, who are not in touch with modern geographic progress. The increasing of the geographic knowledge of the world at large by either of these methods is a proper aim for those interested, and one may be as useful and necessary a task as the other. It may be that success can better be attained by specialization than by a combination of efforts. The *Journal of School Geography* will continue to select facts from the great mass of geographic information, to try and express them in a simple and straightforward manner, and do what it can to help the geographic societies and publications in the wider dissemination of knowledge of the world. This work with the teachers and youth in this generation may bear fruit in the next generation in a larger demand for the consolidation and improvement of the publications of a scientific character.

I agree with Professor Russell that there is need of bettering all the scientific geographical publications in this country. I disagree with him in his idea that there is no room for a journal whose aim is not the publication of new scientific results, but the broader dissemination of geographical knowledge, expressed not in childish, unscientific or pedagogic terms, but in simple English, with a knowledge, on the part of the editors, of the needs and tastes of the readers to whom they would appeal.

RICHARD E. DODGE.
TEACHERS COLLEGE, NEW YORK CITY.

THE DRAINAGE OF THE SAGINAW VALLEY.

TO THE EDITOR OF SCIENCE: Professor Davis has asked me to add a few more instances apropos of his note on the drainage of the Saginaw Valley (p. 337, issue of Feb. 26, 1897). The peculiar circuitous drainage due to moraines of retreat, in which streams do not flow directly to the water of the bay near by, but fetch a compass and make backhanded branches, has numerous other examples in Michigan. Among the most striking are the Sturgeon, which heads in the Huron Mountains, Sec. 9, T. 49N., R. 32E., and flows clear around Keweenaw Bay to empty into Portage Lake, and the region of Grand Traverse Bay, where the Rapid River, Boardman River, Platte River and the Betsie River show a similar type of drainage, which we may call willowy. For in discussing a relation of branches it seems natural to use a term borrowed from botany. A comparison of a drainage map of the Saginaw Valley with the pendent branching of the willow will show the appropriateness of the comparison, and the term can easily be changed by those who prefer Latin terms into salicious.

ALFRED C. LANE.

SCIENTIFIC LITERATURE.

A Dictionary of Birds. By ALFRED NEWTON, assisted by HANS GADOW, with contributions from RICHARD LYDEKKER, CHARLES S. ROY, etc. London, A. and C. Black. [The Macmillan Company, 66 Fifth Avenue, New York.] 1893–1896. 1 vol., 8vo, pp. *i–xii* + *1–124*, i–viii + 1–1088. Map and unnumbered figg. in text.

The ninth edition of the Encyclopædia

Britannica contains a long series of short articles on birds, which have seldom been approached and never equalled for pith and point in the literature of Ornithology. The same publication also contains two extensive articles, under the heads of *Aves* and of *Ornithology* respectively, in which the science itself and the history of the science are set forth in a masterly manner. It does not suffice to call these contributions able and authoritative; they are mainly from the most facile and forceful pen that has ever been bent in the service of the science of which Professor Newton is a foremost exponent and ornament. The whole of these articles have served as the foundation of the present Dictionary, for which purpose they have been modified into something like continuity, so far as an alphabetical arrangement will admit; and supplemented by the intercalation of a much greater number, be they short or long, to serve the same end. "Of these additions by far the most important have been furnished by my fellow-worker, Dr. Gadow, which bring the anatomical portion to a level hitherto unattained, I believe, in any book that has appeared" (Note, p. v). Less numerous though not less valuable articles have been contributed by Mr. Lydekker, and others of great merit by Professor Roy. The result may be correctly characterized as altogether the best book about birds that has ever been written in English or any other language.

Of writings on Ornithology there is no end. As Professor Newton says (*p. 22*), "the desponding mind may fear the possibility of its favorite study expiring through being smothered by its own literature." So huge has the accumulation become that the most expert bibliographer could no more than guess vaguely the total of titles a complete catalogue would contain; no such catalogue exists, nor is likely to ever be produced. The total number of species now known may be somewhere about eleven thousand only; but they will average several synonyms apiece, in Latin binomial form. Generic names in current usage are several thousand, and their synonyms are still more numerous. Non-technical names of birds in English use are derived from almost every language that has been reduced to writing, and a vast number of purely English 'phrase-names' (consisting of more than one word) are employed. We must add to this rough tally all the biological terms which are peculiar to Ornithology, or which this science shares in common with other branches of zoology. A bare list of words which might serve as entries for a Dictionary of Birds would make a bulky volume, without a line of text to define them; and any treatment of such a mass of verbiage in its entirety would be practically impossible, even were it desirable. A majority of such candidates for lexicography make a rubbish heap not worth overhauling. No one knows this better than Professor Newton, who has made no attempt in this work "to include in it all the names under which Birds, even the commonest, are known" (p. v). He characterizes his selection of names to be entered as 'quite arbitrary;' but we may be permitted to testify that his arbitration is that of a tactful expert who understands the beauty of utility, and has governed himself accordingly. How many entries there may actually be we have hardly any idea; the alphabet runs for more than a thousand pages; the articles range from a line or two to several pages, presumably according to the author's estimate of the relative interest or importance of their respective subjects. Regarding the form as distinguished from the substance of the work we cannot do better than here repeat its eminent author's significant words (p. vii):

"I would say that the alphabetical order has been deliberately adopted in preference to the taxonomic because I entertain grave doubt of the validity of any systematic arrangement as yet put forth, some of the later attempts being, in my opinion, among the most fallacious, and a good deal worse than those they are intended to supersede. That in a few directions an approach to improvement has been made is not to be denied; but how far that approach goes is uncertain. I only see that mistakes are easily made, and I have no wish to mislead others by an assertion of knowledge which I know no one to possess; yet with all these drawbacks and shortcomings I trust that this Dictionary will aid a few who wish to study Ornithology in a scientific spirit, as well as many who merely regard

its pursuit as a pastime, while I even dare indulge the hope that persons indifferent to the pleasures of Natural History, except when highly-coloured pictures are presented to them by popular writers, may find in it some corrective to the erroneous impressions commonly conveyed by sociolists posing as instructors."

The 'drawbacks' and 'shortcomings' to which the modesty of a master of the art of exposition and a past master of birdcraft may permit him to allude in speaking of his own performance appear to the present reviewer to be a drawing back from profitless penwork and a coming short of adding anything to the rubbish heap above specified. The plan of the work is not open to any criticism, except it be captious, and its execution is such as makes mere praise seem impertinent.

A respect for precision of statement which verges on scrupulosity is a prime quality of this author's mental furnishing, and his ability to reflect that quality clearly is conspicuous in his literary composition. An ornithologist who should be asked, 'What is a Wagell?' would probably reply, 'A young Black-backed Gull.' This would be right, but not exactly right. We will give what Professor Newton says about this name as a single sample of one of his short 'definitions,' as distinguished from any of the extended articles in this book:

"WAGELL,* the Cornish name of a bird of which Ray and Willughby were told, 30th June, 1662, on Godreve Island near St. Ives in Cornwall (*Memorials of Ray*, ed. Lankester, p. 188, and Ray, *Collection of Words*, p. 93). From what is said of it the Arctic Gull (SKUA, p. 870 [small caps for cross-reference]), seems to have been meant, but they took it to be the young of what we now know as *Larus marinus*, and so the name has been attached to that species by subsequent writers.†"

The Dictionary has appeared in four parts, running 1893–'96, the last part having been issued in November or December of 1896. Besides finishing the alphabet (*Sheathbill-Zygodactyli*) and furnishing the permanent title, preface and indexes, it brings us the cream of the whole performance in its Introduction (*pp. 1–124*). Upon the Britannica basis already indicated Professor Newton has erected an imperishable monument. The task he set himself was nothing short of a critical review of ornithology and of ornithologists in few more than one hundred pages. The result is something to which no other writer who has ever lived has attained. It may possibly add somewhat to the luster of a name already renowned; it will, if any thing can; but certainly it illuminates the whole history of the subject. Professor Newton is unequalled, if not unapproached, by any person now living, in his grasp of ornithological literature, and all the resources of his erudition have been brought to bear upon this summation of his subject, with rare tact and skill, with still rarer sense of historical perspective. It is a masterpiece of composition, in perfect focus and adjustment, without a blurred line from start to finish. Professor Newton is nothing if not accurate in statement of facts, nothing if not cautious and conservative in expressions of opinions, nothing if not scholarly in his modes of locution; these are qualities which all his writings display conspicuously, and we have a right to hold him to them, requiring him never to fall short of a standard of excellence he has taught us to expect to find in his work. But we admire not less, in this instance, what we may call the temper of this piece of writing—so eminently wise, just, kindly, courteous, dignified, and withal of fine academic flavor without a trace of pedantry. In its impersonal aspects, as merely a matter of erudition, it was no easy thing to do; it became one of increased difficulty and great delicacy, in its personal bearings. Professor Newton has relaxed nothing of rigid censorship, maintaining his judicial character throughout, and passing severe sentences in more than one case; but few there will be, we imagine, to dispute the fairness with which he has rendered his even-handed decisions. It was an invidious task, to bring so many of his contemporaries to the bar, to answer for their performances; but it

"* The derivation and pronunciation of this word are unknown to me. It is spelt indifferently by Ray with one *l* or two. I preserve the latter form as possibly indicating a stress to be laid on the last syllable."

"† See *Additions to Borlase's Natural History* (reprinted from *Journ. R. Inst. Cornwall*, Oct. 1865), Truro: 1865, p. 46."

has been executed with scrupulous fidelity. Some offenders will writhe at the point of his pen, as they feel the keen discernment of his criticisms, and others may thank their own insignificance for the charitable mantle of his silence. Meanwhile, this Introduction takes its rightful place as the most valuable and most interesting contribution ever made to the subject of which it treats.

Lacking space for any adequate analysis of this portion of the Dictionary, we prefer to say no more.

ELLIOTT COUES.

Recent Geological Bibliographies. (Bibliography and Index of North American Geology, Paleontology, Petrology and Mineralogy for 1895; F. B. WEEKS; Bul. U. S. Geol. Survey, No. 146, 130 pp.; Washington, 1896. Bibliography of Missouri Geology; C. R. KEYES; Mo. Geol. Surv., Vol. X., pp. 221–523; Jefferson City, 1896.)

Perhaps there are no publications more welcome or more serviceable to the worker in any branch of science than bibliographies. When accurately and conveniently arranged they save the specialist much time, energy and money. One who is not a specialist is even more dependent on them. This is particularly true in our country, where so many who are interested in scientific subjects are necessarily located where library facilities are poor. The worker in some small town, miles, perhaps, from any really good library, learns to carefully treasure all bibliographic matter. Bibliographies render distant libraries more or less accessible, and enable book purchases to be made by mail with the same certainty of satisfactory selection which comes from personal examination. A glance over the list of periodicals examined by Mr. Weeks shows that it is quite complete. Indeed the U. S. Survey library is one of the most complete geological libraries in America. The acquisitions for 1895, as listed here, include 575 titles. In Mr. Weeks' paper there is, under each title, a brief abstract of the contents of the paper noted. This in a certain sense brings the library to each worker, while a visit to the library would be impossible to many geologists, except at great expense.

The survey has from the first recognized the responsibility which comes with the possession of an excellent library, and has issued many helpful bibliographies.* Two of these were compiled by Mr. Weeks, and their wide use has shown that they were carefully planned and conscientiously executed. In the present, as in the preceding papers, the references are full and clear, the abstracts concise and the arrangement convenient. Limits have necessarily been drawn. The proper limits to such a work are a matter of opinion. It would seem, for instance, that signed editorials in standard journals might properly be included, since they often contain much which is germane to current geologic discussion. In this they seem on a par with signed reviews which have been included. While certain trade journals, such as *Engineering and Mining Journal*, have been included, others, which often contain original papers of merit, for example the *Colliery Engineer*, have been excluded. Since so large a portion of the work of the modern geologist has to do with economic subjects, an extension of the scope of the work to include a larger portion of the economic literature would be welcome. Certain of the discussions in such a book as 'The Mineral Industry,'† would probably be as helpful to the working geologist as some of the strictly paleontologic literature noted. This is a criticism, not of the bibliography itself, but upon its possibly too restricted scope.

The paper by Dr. Keyes is on a somewhat different plan. The attempt has been made to bring together all the literature bearing upon the geology of a single State. The result is that a considerable number of titles have been added to the list published by Sampson.‡ There is the same lack, however, of references to important economic literature that is shown by Mr. Weeks' paper. Numerous papers upon the zinc and lead deposits of Missouri have been published in the *Engineering and Mining Journal*, and any one studying the deposits would need to be familiar with these papers, yet none have

*See Bulletins 7, 13, 44, 63, 69, 71, 75, 91, 99, 100, 102, 121, 127, 130, 135.

†Scientific Pub. Co., New York.

‡Geol. Surv. Mo., Bul. 2, 158 pp. Jefferson City, 1890.

been noted. It would seem that, in this case at least, too much has been eliminated. The list is quite complete otherwise. It is particularly rich in references to the geology of the surrounding region. Such side references are especially valuable to workers in Missouri, since they recall widely scattered notes which might otherwise be overlooked. The paper also becomes more than a mere bibliography of Missouri. It is a guide to the study of the geology of the central Mississippi Valley and brings out excellently the development of our present knowledge from a historical point of view. Such a bibliography could only come as a result of wide studies throughout the region and is a natural sequence to the similar publication issued by Dr. Keyes while connected with the Iowa Survey.* The general scope and arrangement of the paper is the same as that followed by the author in the Iowa bibliography. The abstracts are perhaps briefer than those given by Mr. Weeks, but its value is very largely increased by the dictionary arrangement. A not unimportant feature of both the bibliographies reviewed is the very full accompanying index.

H. F. BAIN.

*Iowa Geol. Surv., Vol. I., pp. 209–464. Des Moines, 1893.

SOCIETIES AND ACADEMIES.

CHEMICAL SOCIETY OF WASHINGTON; THE 93D REGULAR MEETING, WASHINGTON, D. C., FEBRUARY 11, 1897.

THE Society was called to order at 8 p. m. by the President, Dr. Bigelow, with twenty-five members and several invited guests present.

The first paper of the evening was read by Dr. E. W. Allen, and was entitled 'A Critical Review of Aikmann and Wright's Translation of Fleischmann's Lehrbuch der Milchwirtschaft,' an abstract of which has been presented by the author: "Attention was called to the heavy verbose style of the translation, and often foggy statements, errors in translating the sense and failure to adapt the book for English and American readers, and to correct certain statements which do not apply at the present status of knowledge. The fallacy of translating a book for students and semi-popular use, without editing the translation and in a measure adapting it to the new field, was pointed out."

Dr. H. Carrington Bolton exhibited two British patents which he has described in SCIENCE (p. 401).

Mr. W. H. Krug read a review, from the German, of a paper by Adolph Meyer entitled 'The Maximum of Plant Production.'

Mr. Wirt Tassin's paper was entitled 'A New Blowpipe Reagent.' He gave a review of the use of iodine in blowpipe analysis from the time of Bunsen to Haanel and Andrews. He then stated that for several years past he had been using iodine in several forms and found that a mixture of equal parts of iodine and potassium sulfocyanate, plus a little sulfur, the whole being intimately mixed, fused and then ground, gave the most satisfactory results. The powder was used as a flux on a gypsum tablet. A series of the iodine and cyanate films produced by some forty minerals was shown. Some of these illustrated the extreme delicacy of the test; others showed the effect that the coating produced by one element had upon that produced by another when they were deposited together; still others showed the methods of differentiating interfering elements. Some attempts at quantitative methods were shown, and attention was called to the fact that a mixture of three parts of alcohol and one part of chloroform burned in a lamp gave rise to some very interesting reactions either with or without the iodine flux.

The Society adjourned at an early hour, and the remainder of the evening was devoted to feasting and social discourse.

SPECIAL MEETING, TUESDAY, MARCH 9, 1897.

A SPECIAL meeting of the Chemical Society was held in the Assembly Hall of the Builders' Exchange Club, under the auspices of the Joint Commission of the Scientific Societies of Washington, to hear the address of the retiring President, Dr. E. A. de Schweinitz, upon 'The War with the Microbes,' which will be printed in SCIENCE. The speaker was introduced by Surgeon General Sternberg, of the United States Army, and the hall was filled with members of

the Society, medical men and over 300 invited guests from the other scientific societies of Washington.

V. K. Chesnut,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON; MEETING OF MARCH 10, 1897.

The Geological Relations of some Southern Iron Ores. By C. Willard Hayes, U. S. G. S.

Notwithstanding all that has been written concerning the Southern iron ores, there has as yet been no satisfactory statement of their geological relations. This is particularly true of the brown ores or limonites. The latter are separated by the writer into two classes, the gossan ores and the brown, valley ores. The latter class is by far the most important. An examination of many hundred deposits in connection with the study of the areal geology of the region in which they occur has led to a classification in three groups depending on their genesis and present relations. The first group comprises a large number of deposits composed chiefly of gravel ore imbedded in red clay near the top of the Knox dolomite. During the period of Tertiary baseleveling, the Chickamauga limestone, which overlies the Knox dolomite, was reduced to baselevel somewhat before the latter, and areas underlain by the limestone received the drainage from adjacent areas of the dolomite. Deposits of bog ore were there formed, and when the limestone was again reduced to a lower level, shortly after the elevation of the region, a part of the ore deposits were left at the altitude of the Tertiary peneplain, forming a fringe about the depressions which resulted from the removal of the limestone. Deposits belonging to the second group occur along the base of Cambrian quartzite ridges where the quartzite passes with steep dip beneath the siliceous limestone underlying the adjacent valleys. The deposits are regarded as segregations of the iron originally disseminated through the limestone, concentrated upon the impervious bed of quartzite during the progressive reduction of the limestone surface. In the third group are the extensive deposits associated with the numerous thrust faults of the region. While the deposits belonging to the two groups above described are due wholly to the surface concentration of disseminated iron, the deposits of this group are produced, in part at least, by iron brought in solution from considerable depths below the surface. Their character depends largely on the kind of rocks cut by the fault. Where these are quarizites the iron may be in the form of ocher directly replacing the silica, or it may occur as the cement in a fault breccia or rarely, filling true fissure veins. The largest deposits occur in connection with faults between quartzite and limestone or between two limestone formations, where they are intimately associated with deposits of bauxite, the hydrated oxide of aluminium, and the two ores are probably closely connected in origin.

Geologic Notes on Kansas, Oklahoma and Indian Territory. By T. Wayland Vaughan, U. S. G. S.

Mr. Vaughan presented the results of a general reconnoissance made from Muskogee, I. T., via Tulsa, I. T., Perry, Enid and Alva, Oklahoma, to Coldwater and Medicine Lodge, Kansas; thence back to Coldwater, and south by Woodward, old Camp Supply, Taloga, Arapaho, to the Wichita mountains, in Oklahoma. The journey from Muskogee to Medicine Lodge was made in company with Professor L. F. Ward. The Wichita mountains were reconnoitered as far west the North Fork of Red River, east of Mangum, and along their northern side eastward to Ft. Sill, at their eastern end; thence eastward, keeping on the north side of the Arbuckle Hills.

Mr. Vaughan considered the Tishomingo granite (of Mr. Hill) in the Choctaw Nation, as probably of Archæan age. The axis of the Wichita mountains consists of solid plutonic masses, forming numerous isolated peaks, or groups of peaks, separated by wide, very level, grass-covered valleys. The mountains are very rugged and precipitous, and rise from several hundred to more than a thousand feet above the valleys between them. A series of the rocks collected was found to consist of hornblende granites, which form most of the mountains, and an interesting series of gabbro rocks. The rounded hills northwest of Ft. Sill are composed of quartz poryhyry. The age of the plutonic axis of the Wichita mountains is still undeter-

mined, but as the Red Beds (Permotrias) were found resting against one of the granite mosses, with an arkose at their base, it must be older than the Permian. The Silurian was found north of the Wichita mountains, forming hogbacks, and at Ft. Sill the fossils showed the limestone to be Ordovician. Ordovician and Upper Silurian strata were found north of the Arbuckle Hills.

No definite line could be drawn between the Carboniferous and the Permian, or between the Permian and the Trias.

In discussing the Cretaceous (Comanche Series) the following facts were noted: In the vicinity of Belvidere, Kansas, the Cretaceous extends above the highest divides, but is deposited upon the eroded surface of the Red Beds. As one goes southward the Cheyenne sandstone member disappears, the Kiowa shales become thinner, and the cretaceous beds rest against the sides of the Red Bed hills. Ten miles northwest of Taloga, and in the vicinity Arapaho, the Cretaceous is an agglomerate of *Gryphæa forniculata* (White), the *G. pitcheri* of Marcou, a few feet thick. The *Gryphæia tucumcarii* of Marcou, a fossil asserted by him to be Jurassic, often occurs imbedded in the same matrix.

The Great Plains formation does not extend as a continuous formation east of a line from Alva to Woodward, Taloga and Arapaho, nor south of Arapaho.

There were also communications on 'Oscillations of the Coast of California, during the Pliocene and Pleistocene,' by H. W. Fairbanks, and on a 'Discovery of Marine Cretaceous deposits in Eastern Virginia,' by N. H. Darton; but these are here referred to by title only, for want of space.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

February 4, 1897. THE meeting was devoted to the annual address of the retiring President, C. L. Marlatt.

The address was entitled 'A Brief Survey of the Science of Entomology from its Beginning to the Present Time.' A running account was given of the history of the study of insects and of the persons who have been most prominent in such work from the earliest times to the present, classified in accordance with their relation to prominent men or well marked periods. With the historical summary as a basis, estimates were made of various phases of the results of the study, as follows: An estimate was given of the total amount of the literature of entomology, considered both at the various past periods and at the present time. It was stated that the total writings on insects would probably amount to between 12,000 and 15,000 volumes of 500 pages each. The actual number of persons interested in the study of insects at various times was estimated, and from various sources of information it was deduced that there are from 3,000 to 4,000 persons now living who, either as students, writers or collectors, are interested in the science of entomology. The address concluded with a summary of the results so far accomplished, particularly in the field of systematic entomology and the relation this bears to what remains to be done. The estimates were based upon the actual number of described species, in comparison with the estimates of species still to be described or discovered, and also in connection with the present rate of progress as indicated by the annual or periodical works of record in zoology.

March 18, 1897. Mr. Ashmead showed specimens of *Halobatopsis beginii*, recently described by him in the *Canadian Entomologist*.

Dr. Motter read letters from Dr. Wyatt Johnson, of Quebec, and Garry de N. Hough, of New Bedford, giving accounts of investigations by both observers of the fauna of cadavers, and showing in what respects their results differed from his own.

Mr. Busck exhibited six larvæ of *Anthrenus varius*, each of which showed well marked wing pads on the second and third thoracic segments.

Mr. Ashmead read a paper entitled 'Five new hymenopterous parasites from *Canarsia hammondi*.' These parasites were among a series reared by Mr. W. G. Johnson in Illinois, in the course of an investigation of the host insect. The new species were *Spilocryptus canarsiæ*, *Limneria canarsiæ*, *Apanteles canarsiæ*, *Elasmus meteori* and *Tetrastichus cœrulescens*.

Mr. Ashmead also read a paper entitled 'A

new species of Roptronia.' The type was collected by Mr. Garman in Kentucky.

Mr. Howard read a paper entitled 'On some parasites of Coccidæ,' in which he referred to the extraordinary geographical distribution of certain of the forms. *Aspidiotiphagus citrinus* (Craw), for example, has been found in many localities of the United States; at Grenada, B. W. I.; Portici, Italy; Punduloya and Kandy, Ceylon; Hong Kong and Amoy, China; Tamsui, Formosa; Yokohama, Japan; Newlands, Cape Colony; Brisbane, Queensland; Adelaide, South Australia; and Honolulu, Hawaii. He also showed that *Arrhenophagus chionaspidis* (Aurivillius) has an almost equally universal distribution, and announced the finding of the hitherto unknown male of this species in some material reared by Mr. Koebele at Macao.

A paper by Mr. W. J. Fox, entitled 'The species of the genus Pepsis found in America north of Mexico,' was read by title.

A synopsis of a paper entitled 'Notes on bred parasitic Hymenoptera, with descriptions of new species,' by Geo. Dimmock and Wm. H. Ashmead, was presented by Mr. Ashmead.

L. O. Howard,
Secretary.

NEW YORK ACADEMY OF SCIENCES, SECTION OF GEOLOGY, MARCH 15, 1897.

The first communication of the evening was by Mr. Heinrich Ries, entitled 'Mineralogical Notes.' Mr. Ries spoke of some Allanite crystals with new faces; also of some large crystals of fibrous gypsum from Newcastle, Wyoming; also exhibited some large Childrenite crystals from Maine, and some Amphibole crystals with many terminal faces from Virginia. He also spoke of some Pseudomorphs of gold after Sylvanite from Cripple Creek, Colorado. The finding of a new Beryl crystal, with an unusually large number of terminal faces in New York City, was also noted.

The second paper of the evening was written by Mr. Herbert Bolton, entitled 'The Lancashire Coal Field of England,' and read in abstract by President Stevenson. The paper spoke of the geographic conditions of the Lancashire coal field and its neighborhood, of the extent and quality of the coal and of the age of the structural movements which had caused the present geological characteristics in the coal area. A careful correlation was made between the Coal-measures of this field and the deposits of the United States. Distribution of the fauna and flora and their character was taken up in some detail, and it was shown that in the Lower Coal-measures the life is mostly marine, in the Middle Coal-measures of fresh and blackish origin, and in the Upper Coal-measures that the fauna was scarce. When published, this paper will be a valuable contribution to the literature of coals and will be of great assistance to workers in America in their endeavors to correlate the deposits on the two sides of the water.

The third paper of the evening was by Mr. Stuart Weller, of Chicago University, entitled 'The Batesville Sandstone of Arkansas,' and abstracted by Mr. Gilbert van Ingen. The paper entered into some detail regarding the Batesville section and the fauna of the Batesville sandstone in that section. Of the invertebrates thirty species have been found, of which eleven point to the St. Louis age of the sandstone, six to the Kaskaskia age, while thirteen are of indeterminate value. On account of the greater abundance of the numbers of specimens of the second group and from stratigraphic evidence as well, it is probable that the sandstone belongs in the base of the Kaskaskia group and is the same as the Aux Vasa limestone of southern Illinois. This paper gives the data wherewith to correlate the Mississippian section with the section about the Ozark Hills.

Richard E. Dodge,
Secretary.

NEW BOOKS.

Diseases of Plants induced by Cryptogamic Parasites. Karl Frelherr von Tubeuf. London, New York and Bombay, Longmans, Green & Co. 1897. Pp. xv+598.

The Fern Collector's Handbook and Herbarium. Sadie F. Price. New York, Henry Holt & Co. 1897. 72 figures.

Electricität direkt aus Kohle. Etienne de Fedor. Wien, Pest, Leipzig, A. Hartleben. Pp. vi+304. Mark 3.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, APRIL 9, 1897.

CONTENTS:

The War with the Microbes: E. A. DE SCHWEINITZ..561
The Growth of Children: FRANZ BOAS.....570
The Promise and Potency of High Pressure Steam: R. H. THURSTON.....573
The Origin of the Teeth of the Mammalia: HENRY F. OSBORN.....576
Zoological Notes:—
The Sharp-tailed Finches of Maine: A. K. FISHER.577
Current Notes on Physiography:—
Yellowstone National Park; Bearpaw Mountains, Montana; Laurentian Highlands of Canada; Maps of Mt. Desert: W. M. DAVIS.....577
Current Notes on Anthropology:—
The Progress of Anthropology; The Lumbar Curve; Native American Mysticism: D. G. BRINTON....578
Scientific Notes and News.....579
University and Educational News.....584
Discussion and Correspondence:—
Diffraction of X-Rays obtained by a New Form of Cathode Discharge: R. W. WOOD. *The Height and the Velocity of the Flight of a Flock of Geese Migrating Northward:* H. HELM CLAYTON. *Archæological Discoveries made in the Gravels at Trenton:* G. FREDERICK WRIGHT, D. G. BRINTON. *An Imaginary Fleet:* G. D. HARRIS. *The Metric System:* BURT G. WILDER.....585
Scientific Literature:—
The Formation of the Quarternary Deposits of Missouri: O. H. HERSHEY. *Peters' Angewandte Elektrochemie:* EDGAR F. SMITH.....587
Scientific Journals:—
American Journal of Science; The Astrophysical Journal.....589
Societies and Academies:—
Zoological Club of the University of Chicago. The Anthropological Society of Washington: J. H. MCCORMICK. *The New York Academy of Sciences—Biological Section:* BASHFORD DEAN. *The Torrey Botanical Club:* EDWARD S. BURGESS.....592
New Books.....596

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE WAR WITH THE MICROBES.**

FROM the moment that man made his appearance in the world there has been perpetual warfare between himself and everything animate and inanimate upon the earth. To a great extent this has been an aggressive strife, man's every effort being exerted to compel nature to contribute to his comfort, welfare and advancement by the subjugation of her materials and forces. It was many centuries, however, before he recognized that there were certain unknown insidious enemies, which often rendered fruitless his simple household occupations, defied his every effort at control and sometimes menaced even his well-being and life. Though in 1675 Leeuwenhoeck discovered, with a powerful magnifying glass, certain minute organisms in decomposing animal matter, it was not until nearly two centuries later that their true significance was recognized, and Davaine first demonstrated the positive connection between these minute forms of life and disease. When animal and vegetable life ceased, in accordance with the laws of nature, they were supposed to be changed by purely chemical actions, so that their elements were again returned to the earth and air to supply food for other plants and animals. This destruction was considered to be wrought simply by the oxygen of the air, and the process of

*Address of the President before the Chemical Society of Washington, March 9, 1897.

fermentation was thought to be due to a similar cause. It had been known for ages that the juice of the grape, if allowed to stand, underwent changes by which its character was modified and wine was formed, or this change might be allowed to progress further until the juice had been converted into vinegar and finally carbon dioxide gas and water. These alterations, those which take place in the digestive tract of animals and are involved in the conversion of dead animal and plant matter into their simplest constituents, were classed under the general head of fermentations.

The fermentations, especially that of wine, an Italian chemist, Fabroni, in 1822, supposed to be induced by a substance of vegetable origin, but closely allied to the white of egg. He considered this material identical with the gluten of cereals and gave to it the name of the 'principle vegeto-animal.' For nearly forty years afterwards this theory was applied by chemists to all fermentations. It was supposed that the albuminoid substance present exposed to the oxygen of the air experienced a progressively variable alteration, that diverse modifications of matter were produced which constituted the ferments of diverse nature. The fermentation was the result of the molecular movement thus communicated. These theories were based upon an erroneous interpretation of what occurred under certain conditions. There exists in wine, when it is being converted into vinegar, a substance which acts to bring about this modification, but this is not dead albuminoid matter, but a living plant. This fact the lamented chemist, Pasteur, demonstrated in his careful studies upon the production of wine and its conversion into vinegar. Before this time, it is true, there were many who failed to accept the theory of spontaneous oxidation, and endeavored to show that if fermentable liquids were boiled in flasks which were then immediately sealed, the fermentation could not take place. But this did not fulfill the demands of one school of chemists, viz., that plenty of oxygen gas should always be present. When the liquid was boiled in contact with air which had previously been drawn through sulphuric acid, it was claimed that the air had undergone some chemical change, so it was not until 1854 that this objection was overcome by previously passing the air in the presence of which boiling took place through cotton, and it was then that this school of chemists found their theories in danger. Pasteur demonstrated that the plant present in the preparation of vinegar was the simplest form of life, a cell which could be easily destroyed by heat. Its presence was absolutely necessary for fermentation, and without the living cell no amount of dead vegetable matter could cause the peculiar molecular disarrangement which had been claimed. While Liebig had contended that as long as the juice of the grape remained away from contact with the oxygen of the air the necessary motion could not be imparted to the molecules, which movement subsequently caused the phenomena of fermentation. Thus was brought to an end the strife between the two schools of vitalists and chemists; the one school of chemists demanding the presence of ogygen only, the other the presence of a living plant cell in addition to oxygen. From this strife of the two schools was evolved in reality a new science and new theories, which have made the past thirty years marvelous in their explanations of many of the simplest phenomena of plant and animal life and death, placed the practice of medicine upon a scientific basis and rendered possible an intelligent system of agriculture and animal husbandry.

Pasteur's discoveries also served to explain the true cause of the poisonous properties of spoiled meats and other foods, stagnant

water, and water from marshy countries. For more than half a century before this time a number of investigators had proved the dangerous character of old sausage meats, bread and the like. Kerner concluded that they contained a fatty acid to which the poisonous action was due; others confirmed these ideas and came to similar conclusions in regard to poisonous cheese. In 1856 Panum asserted, as a result of his studies upon the poisons found in putrid animal matter, that these poisons might be formed by some active plant cell, but their injurious effect was independent of these cells. He demonstrated that fixed non-volatile poisons could be extracted from putrid matter which were soluble in water and alcohol, not destroyed by heat, and produced the same effects after they had been submitted to a high temperature as before. These poisons he found to be intense in their action, 0.012 grams sufficing to cause the death of a small animal. In 1866 Bence-Jones obtained from the liver a substance which, with dilute sulphuric acid, gave a bright blue fluorescence like that noted in similar solutions of quinine. Probably this was the product of what we now call fluorescing bacteria.

The work of Pasteur threw light upon the origins of these poisons. As the ferment causes the alteration in the grape juice, so do microscopic forms of life bring about the changes which take place in dead animal and vegetable matter, and also those conditions in the living body which we call disease.

Many of these microscopic forms of single-celled plants, *the bacteria*, have their natural habitat upon dead organic matter, but they may flourish in the living body and are almost unlimited in variety, appearance and behavior. It is possible also to cultivate them upon specially prepared solutions after their individual peculiarities have been studied. Some thrive best in light, others in darkness; some like a goodly supply of oxygen, others prefer nitrogen; some are very sensitive to changes of temperature, while others readily accustom themselves to vicissitudes.

These different bacteria further are somewhat eccentric within as well as without the animal body. Some, as the diphtheria germs, find their most comfortable habitat upon certain mucous membranes, others in the lungs, some in the digestive tract, still others in the blood, while others again confine themselves to certain external cells and membranes. In their artificial cultivation this eccentricity is equally apparent. While nearly all thrive upon a beef broth, some prefer the beef broth with an excess of acid, others with an excess of alkali. Some demand the addition of sugar or glycerine, others the addition of sugar together with acid, while some are satisfied with a diet of phosphates, salt and water. These peculiarities have to be studied for each germ, and while many can accommodate themselves to their surroundings, and while the same germ grown upon different media produces the *same substances*, the amount of each substance is a varying one, and in cultivating them artificially we must find which diet gives rise to the largest amount of the most active products.

Shortly after the work of Panum just referred to, the Italian chemist Selmi outlined methods of extracting poisonous principles from dead animal matter, and gave to these substances the name ptomaines, on account of their origin. Later, in 1876, the first analysis of a ptomaine was made by Nencki and its formula determined. Further experiments showed that volatile and non-volatile substances, alkaline in character, could be obtained from various portions of the animal body, often from fresh material and also from the cultures of bacteria. These ptomaines were found to resemble the alkaloids in their chemical reactions.

In 1882–83 Brieger succeeded in separa-

ting and determining a number of these ptomaines, from the brain, from fish muscarin, from decomposed glue, neuridine and dimethyl amine, muscarin, etc. From pure cultures of the typhoid germ he obtained a substance, typhotoxin, which produced typhoid symptoms, and from cultures of the tetanus germ tetanin, which caused convulsions. The presence of similar poisonous bases was demonstrated in cultures of the cholera, hog cholera, anthrax, pyogenes aureus and like active bodies were isolated from cheese, milk, ice cream, sausage and other foods which had caused sickness.

The isolation of these poisons from bacterial cultures gave rise to the belief that they were the bodies which caused the fatal effects of disease. But while in many instances they produced the characteristic symptoms, in others they were not sufficient to account for all the phenomena. For example, from cultures of the tetanus germ it was possible to isolate a base that had but slight poisonous properties, while the culture liquid from which this was obtained after all the germs had been removed was ten thousand times more poisonous than the base secured. Non-poisonous ptomaines were also obtained from cultures of disease-producing bacteria, and, in fact, the majority of ptomaines were found to be non-poisonous.

The next question was, if in the culture liquids freed from bacteria, poisonous substances are obtained, and if they do not belong to the class of ptomaines, how shall they be identified and classified? In 1886 Mitchell and Reichert, while studying the venoms of serpents, noted that these poisons belonged to a class of bodies different from the ptomaines, viz., to the group called proteids. Shortly after, Roux and Yersin, in their studies upon the diphtheria poison, demonstrated that this was a substance which resembled the ferments and led them to think that an enzyme, as it is called, a substance like pepsin, was the active poison, and that this enzyme was in some way elaborated by the germ. Other investigators had found a similar substance in tetanus and hog cholera cultures, and a reinvestigation by Brieger of a number of bacterial cultures showed that by precipitation with ammonium sulphate and alcohol very poisonous substances giving proteid reactions could be obtained. Proteids of various characters belonging to different classes were obtained from cultures of many bacteria. About this time it was shown that certain plants of a higher order contained poisonous bodies of a like proteid character. An albumose abrin was obtained from the Jequirity seeds and ricin from the castor-oil bean. These were intensely poisonous, $\frac{1}{100000}$ of a grain of abrin being sufficient to kill an animal weighing one kilogram, or the $\frac{1}{100}$ of a grain should be a fatal dose for a man weighing about 130 pounds.

A relationship was thus established between the poisons from higher plants and from the lowest plants and certain animals. Was this poisonous property of these bacterial substances due to a true proteid, or was there an admixture of an active ferment-like substance with the proteid, and are these poisons mechanically carried down in the process of precipitation of the albuminoid matter in the culture liquids? Experiments show that while the poisons may be proteids, it is more than probable that they are simply carried down with proteid matter as indicated. Brieger in 1893, in view of the results so far obtained, endeavored to isolate the pure poison from cultures of the tetanus bacillus. The cultures were first filtered through porous porcelain, a Chamberland or Monroe filter tube, for instance, and the liquid which passed through was treated with a concentrated solution of ammonium sulphate. This preciptated the poisons and a number of other substances

which gave proteid reactions. After purification and dialysis the poison was obtained as yellow soluble flakes which no longer gave proteid reactions. It was a substance in which there was no noticeable phosphorus nor sulphur. It was thus proved that the tetanus poison belonged neither to the ptomaines before referred to, nor to the proteids. The poison, while not perfectly pure, was purer than any ever before obtained, and was so poisonous that a mouse weighing ½ oz. was killed by $\frac{1}{1,128,000}$ part of a grain, while $\frac{1}{280}$ of a grain should kill a man weighing 150 lbs.

It is not difficult to understand how if the tetanus bacillus outside of the body can produce such powerful poisons, it can give rise in the animal organism to serious troubles. The diphtheria bacillus is another germ which forms very powerful poisons in the solutions upon which it feeds. As already mentioned, some authors, Roux and Yersin, believe that this poison also belongs to the ferments like trypsin and pepsin, while Brieger and Fraenkel thought it was a toxalbumin. We find after the germ has been removed from the culture liquid by filtration, that the poison can be separated by calcium phosphate or ammonium sulphate, just like the tetanus poison. In the purest condition in which it has been so far obtained it fails to give the proteid reaction, and $\frac{1}{64}$ of a grain will kill a guinea pig. It dialyses readily. Bodies of a similar kind have been obtained from cholera, glanders, swine plague, tuberculosis, and anthrax cultures, while many other bacteria produce soluble intensely poisonous substances in artificial cultures as well as inside the animal body.

These products are all characteristic of the individual organism. The conditions under which the most poisonous ones are formed seem to be dependent partly, we may say, upon the humor of the germ and also upon the food offered for its use. It appears, for example, in connection with the diphtheria germ that, if there happens to be present in the beef broth upon which it is being cultivated, an undue amount of glucose and an insufficient supply of alkali, that, instead of producing a very active poison, the substance secreted is much less harmful. This is accounted for by the supposition that the glucose is decomposed into acid which, in its turn, neutralizes or decomposes the poison ordinarily produced by the germ. These poisons, it was originally supposed, resulted from the decomposition of the food of the germ, just as soluble and assimilable albuminoids are produced by the acids and ferments of the animal body from the insoluble albuminoids that are ingested as food. It has been found, however, that in most instances the poison of the germ is in solution in quantity only after the germs themselves have become partially disintegrated. In other words, the active bacterial poisons seem to be products of the cell and retained within the cell until the latter dies and the cell membrane is broken, permitting the passage into the surrounding liquid of the poison. What then is the true nature of these poisons if they belong neither to the bases nor to the proteids or toxalbumins? That, unfortunately, is one of the problems to which, up to the present time, chemical research has not been able to give a definite answer; and this, because, as we have already noted, the poisons of these bacteria are so tremendously active and consequently produced in proportionately small amount, even when a large quantity of the culture media is used, that it has so far been a matter almost of impossibility to separate a sufficient quantity of these poisonous principles to purify them perfectly for chemical analysis. Perhaps this object has been attained more nearly than ever before by some workers in the Biochemic Laboratory in this city, who have succeeded in

separating from cultures of the tuberculosis germ a crystalline poison with constant melting point and a constant composition. This is not the only poison produced by the tuberculosis germ, but that it is one of the principles which is responsible for much of the trouble with this disease is beyond doubt. These special poisonous principles, which are so difficult to obtain pure, we designate by the name toxines, to distinguish them from the ptomaines and proteid substances before mentioned. Another difficulty which is always encountered in extracting the poisons of bacteria is their instability. The material with which an experiment is begun may be very poisonous, but the processes of precipitation and extraction through which it must be passed in order to obtain a desired substance are such that often, long before the final stages have been reached, the nature of the poisons has undergone an entire change due to the chemical processes which have necessarily been applied.

We have said that the poisons of the germ were synthetic products which were built up within the cell wall. Some of these easily pass through the cell wall, due probably to the greater permeability of the living membrane; others are retained within the cell wall only to pass into solution when these walls are broken down. Tetanus, diphtheria and swine plague allow this diffusion to take place very rapidly, while with other germs, like typhoid fever, anthrax, cholera, glanders, tuberculosis, the poison is produced and retained within the cell more firmly during the life of the latter. As the germs die, however, in artificial cultures, the cell walls gradually disintegrate and the poison passes out into the surrounding liquid. In the case of tuberculosis and glanders a strong solution of these cell poisons in the surrounding liquid upon which the germ has been feeding gives tuberculin and mallein, the two diagnostic agents which have been of inestimable value in detecting latent disease in men and animals and thus preventing the spread of untold evils.

Thus the warfare first began by the chemist with the microbes in identifying their character and relation to disease has been prosecuted for little more than a decade in endeavoring to detect the true character of the insidious poisons with which their arrows are tipped. To a certain extent, as we have seen, this warfare has been a successful one in so far that the poisons have been hunted and driven to their last stronghold, which, ere long, with the many workers in attack, must yield as heretofore to superior forces. But while this search for the pure poisons has been in progress the chemist has not been idle in endeavoring to counteract these poisons, the nature of which he did not thoroughly understand, but the evil effects of which were only too apparent. While Jenner in vaccination for small-pox, and Pasteur with his method of vaccination for anthrax, had shown that it was possible to protect animals and men from a virulent attack of disease by giving them first a mild attack, (though, by the way, there are a few who contend even to-day that vaccination is useless), it remained for Salmon, his assistant, and Smith in this city to demonstrate, in 1882, that the poisons of germs could be used by men and animals to fortify themselves against the attacks of these same bacteria. This could be accomplished by introducing into the circulation of the animal a small quantity of the poison of the germ, so that when the germ itself was injected the poison which it produced was without effect. What had been found true for one disease of animals proved also to be true for many others, and chemical vaccination was tried for diphtheria, tetanus, anthrax, cholera, typhoid fever, tuberculosis, glanders and a number of other diseases.

But this discovery led to another, important and far-reaching. Fodor showed that the blood serum of animals, made immune to a particular disease by injecting the animal with the poison which this germ formed, had the effect of destroying the germ of the disease. This excited renewed interest in the study of the blood, and within a few years it was demonstrated by the work of many, some in this city in the laboratories before mentioned, that this serum from previously immunized animals, not only had the property of conferring immunity upon other animals, but also of checking the disease after it had once begun. How thoroughly this fact was demonstrated, first by Behring and subsequently by Roux and others in connection with diphtheria and tetanus, has been dwelt upon often, and we know of the many thousands of lives that have been saved by the use of antitoxic serums.

To prepare these the solution of the toxins, which we have before described, are injected into different animals, preferably horses, and at the end of six to twelve weeks the blood of these animals is found to yield a serum containing substances possessing both immunizing and curative properties which we call antitoxines. The active principle of this serum is present in a comparatively small quantity, but its influence is enormous. It does not appear to be a substance which directly chemically neutralizes the poison, but counteracts its effects within the animal in some unknown way.

But some of our friends may ask: Were not these facts discovered first by the use of animals, and hence has not this knowledge, though of inestimable value to mankind, been too dearly bought? Yes, perhaps, a score or two of guinea pigs and sweet, lovely rats and mice have sacrificed their lives for humanity's sake. But this knowledge could not have been gained in any other way unless by the sacrifice of human life. What mother would hesitate to sacrifice a thousand guinea pigs for the life of her child, or, on the other hand, would wish her child to serve as the subject of experiment for others?

I have often been asked if the horses placed under this treatment for the production of antitoxines suffer. I think not and, as an illustration, will relate an incident which has come under my own observation, in the study of the antitoxins of the dread disease, tuberculosis. A well-blooded horse, gentle in every particular, except that he would run away upon the slightest provocation, seemed to be a suitable subject for some work. Accordingly he received an injection of the poison of the tuberculosis germ with the expectation that so high strung an animal would rebel against these pleasant familiarities. But he was entirely too wise for this. He submitted quietly and seemed much interested while by means of a hypodermic syringe a small quantity of the poison was ejected beneath his skin. A few days afterwards when the operation was repeated it would have been reasonable to expect that if there had been any discomfort the horse would have rebelled against the procedure. Did this happen? Not by any means. As soon as he observed the doctor appear with the syringe and bottle he trotted toward him with pleasure, stood quietly looking around with intelligence, while the injection was made and ever afterwards lent himself to the experiment with as much evident pleasure and interest as that of the investigators, apparently thoroughly appreciating its object.

It would hardly be fair to say that this dumb animal was endowed with more intelligence than some of our ill-informed but well-meaning friends, and yet would its actions not seem to indicate a high regard for scientific work and disclaimer of suffering?

Is it that they are instigated by a desire to inflict torture that scores of investigators

have sacrificed their lives in searching for the poisons of dangerous bacteria and their antitoxins? Is it inhumanity which spurs them on at imminent personal risk in their efforts, which are daily yielding new and brilliant results to find means for controlling a disease which annually causes one-seventh of the deaths of the population of the globe?

However, it is not only for protection against the two diseases, tetanus and diphtheria, just mentioned, that antitoxic serums can be prepared. Recent investigations have proved that typhoid fever, cholera, anthrax, the plague, etc., are amenable to similar treatment and in the same department in this city that chemical vaccination received its first impetus, but by workers in the Biochemic laboratory it has been demonstrated that two diseases that cause such losses to the farmers of the country may be controlled by antitoxic serums. Investigators in this same laboratory have shown also that a substance antitoxic to tuberculosis can be produced in the serum of animals when they are properly treated, which has undoubted and pronounced effect in checking experimental tuberculosis in small animals. When we inquire the character of these antitoxins we are almost as yet more in the dark than in our efforts to discover the exact nature of the poisons of germs. However, it has been possible to separate in a fairly pure form the antitoxic principle from diphtheria serum, a minute amount of which will confer immunity and the antitoxic principle of swine plague, .002 g. of which has been found to cure animals weighing 1 pound, and even a solid antitoxic-like substance for tuberculosis has been obtained in an impure form. All these solid antitoxic principles resemble each other very closely in their chemical tests and methods of separation showing albuminoid reactions, but in their curative properties they are totally independent the one of the other. The diphtheria antitoxic serum does not cure tetanus; the swine plague serum does not cure the cholera.

In the case of the venom of serpents it has been found that repeated injections will make the serum of an animal antitoxic and curative against other venoms. The antitoxic serum produced by the cobra venom will protect animals and men against the bite of the rattlesnake as well as its own bite. It would seem from this that there is a very close relationship between the poisons of venomous snakes and that immunity to one also gives protection from the other. It appears very probable also that the poisons of germs belonging to the same genus will be closely allied and that an antitoxin for one will also be an antitoxin for the other. In fact, it has been demonstrated that the products of the bacillus coli communis will protect animals from the typhoid germ to which it is closely allied. The same effect will probably be found with many other diseases where the germs are related.

The difficulty of separating these antitoxins completely from the other constituents of the blood has made it impossible as yet to obtain positive information as to their true chemical character.

As to their action in producing immunity one theory is that they directly neutralize the poisons which the germs produce, but this does not seem to be substantiated by experiment.

Another theory proposed first by Sternberg, then by Metchinkoff, ascribes immunity to the action of the white blood corpuscles upon the bacteria, while the third theory, and the one which seems most tenable in view of actual results, is that the antitoxic principle partakes of the nature of an unorganized ferment like diastase, and that its action in the body, with the aid of the leucocytes, suffices to render innocuous the poisons of the particular germs.

There is little room for doubt that in the first instance the antitoxins are the result of cell activity upon the introduced poison. Just how the cell manages to convert the toxin into antitoxic ferment is not known, probably by absorption of the toxin and subsequent secretion of the antitoxin within the cell-wall. Every added dose of toxin finds not only the leucocytes but a ferment to aid in its decomposition, and so the change proceeds more rapidly and the immunity is increased. Exactly what the chemical alteration in this instance is, has not been explained, but that there is oxidation, and molecular rearrangement of the toxin seems to be probable.

Thus without taking into consideration the destruction of the causes of disease, viz., germs themselves, by means of such excellent disinfectants as formaldehyde, has the warfare against the microbes progressed. Although as we learn more of the properties and uses of their toxins we are almost forced to confess that it is not a warfare, but rather that man is learning how to train and control these microscopic forms of life as centuries before he learned how to control the animals and higher plants.

Our ideas of germs are so thoroughly associated with disease that we often forget that these germs are but the simplest forms of plant cells which are endowed with various functions. The majority of them are not injurious to man, but very useful fellow-workers if he has once learned how to manage them. The value of this cell life in the production of wines, beer and other fermented liquids is too well known to need more than passing mention. But you may not all know to what extent the aroma and flavor of butter and cheese are due to the products of micro-organisms. Now these products are frequently ethers and esters, sometimes acid and acid derivatives or amines, the latter a class of compounds to one of which smoked herring owes its particular flavor and which is also formed by a number of bacteria.

When milk is first collected from healthy animals it is almost free from germs, but exposed to the air it soon becomes filled with those forms of life which are perfectly harmless. If placed under suitable conditions with regard to temperature they will multiply very readily and the milk becomes sour, due to the formation of lactic acid produced from the sugar in the milk by one or more of these germs. If the germs present happen to be those giving an ether and ester which have a pleasant flavor and aroma, good butter can be made, but if they give rise to the formation of disagreeable thio, ethers and esters or some amines, the butter is poor and bad

Now, by isolating different germs found in the milk and cultivating them separately, so as to discover their own peculiar product, it is possible to always make butter of the same sort and flavor by first destroying the other germs present by Pasteurization and then inoculating the cream with the particular germs desired. A number of germs have been isolated from milk which will produce good butter, and any one of them is, perhaps, as satisfactory as the other, the etheral product being slightly different and more palatable to different individuals. Of course, a great many germs have been found in milk which produce disagreeable compounds and it is not possible to tell from their appearance simply, which will be desirable plants, but it is easy to cultivate them in a small quantity of milk, note the results and select the desirable plant cells.

Fortunately or unfortunately the use of these germs has been patented, so that in the near future we may see branded upon particularly fine butter and cheese patented in 1893, amended 1896, reissued 1908, etc. May we expect soon a patented process for sterilized breathing, eating and sleeping?

Recently it has been found that malt if inoculated with a particular ferment from the skin of the grape will be converted into wine, the ferment used giving rise to the formation of characteristic ethers, so it is certainly not beyond the limits of possibilities that in the near future American beer after a voyage to France may return as excellent champagne. When we discover too a germ (as had been done recently) that converts starch into cellulose, we are almost led to wonder if it might not be possible to produce cotton in a culture flask if the particular germs were supplied with nutritious food and a sufficient amount of carbon dioxide, oxygen and water.

The flavor of many lucious fruits and foods is due to the products either directly or indirectly of one or more of these useful bacteria, and on the other hand similar germs play an important and as yet unknown rôle in the formation of poisonous alkaloids.

Many bacteria form beautifully colored substances, reds, yellows, blues, greens and delicate shades which the art of man has not been able to imitate and the nature of which he has not yet learned. These, too, are only hiding their secrets with a thin veil which investigation will soon withdraw.

But it is not only in simple industrial processes that the products of germs are important. Man's very existence, while menaced on the one hand by a few germs, is on the other dependent upon their activity. The germs which in the soil produce nitrous and nitric acid and ammonia, and aid their assimilation by the plants, those which facilitate the decomposition of phosphates and bring the phosphorous, a so necessary constituent for the life of plants and animals into an available form, and those which aid in the destruction of dead vegetable and animal matter, play a very valuable and but little appreciated part in the continuance of the life and well-being of man.

There are many other ways in which the products of these dreaded microscopic cells are useful, but all, a very insignificant number of which we have mentioned, are only waiting man's bidding to become valuable subjects, and to show that, as has been instanced in the history of nations, conquered people often make the best and wisest citizens.

E. A. de Schweinitz.

Washington, D. C.

The Growth of Children.

In the years 1891 and 1892 I collected statistics on the growth of children in Worcester, Mass., mainly with a view to investigating individual growth. Although it was not possible, as was my original intention, to continue the series through a number of years, some results of interest have been obtained. The measurements were taken partly by myself, partly by fellows and students of Clark University. I am indebted to Dr. G. M. West for many of the measurements.

The stature of the same children was measured in May, 1891, and in May, 1892. The average annual increases and the variability of the amount of growth (the mean of the squares of individual variations) for these intervals were as follows:

Average Increases in Stature of Children Between the Following Years (*cm.*).

	5 and 6	6 and 7	7 and 8	8 and 9	9 and 10	10 and 11	11 and 12	12 and 13	13 and 14	14 and 15	15 and 16
Boys	6.55	5.70	5.37	4.89	5.10	5.02	4.99	5.91	7.88	6.23	5.64
Girls	5.75	5.90	5.70	5.50	5.97	6.17	6.98	6.71	5.44	3.34	—

Variability of Annual Growth.

Boys	———	±0.68	±0.86	±0.96	±1.03	±0.88	±1.26	±1.86	±2.39	±2.91	±3.46
Girls	±0.88	±0.98	±1.10	±0.97	±1.23	±1.85	±1.89	±2.06	±2.89	±2.71	———

This table shows that young children grow more uniformly than older children. The increasing variability is very great during the years of adolescence. After this period it must necessarily fall. It disappears as soon as all the individuals have ceased growing. This increase in variability must be considered due to the effect of retardation and acceleration of growth. During the period preceding puberty some individuals will have reached their full growth, while others are still growing at a very rapid rate. As the rate of growth during the early years of childhood does not vary very much, retardation and acceleration will not have any effect of this sort. For the same reason the distribution of amounts of growth during the years preceding puberty is very asymmetrical and must be more so for the years from 17 to 20, for which I have no observations. It will be noticed that the growth of girls is more variable than that of boys.

I have furthermore divided the series for each year in two equal halves, the one embracing the tall children, the other embracing the short children. The average annual increases of these two groups are as follows:

AVERAGE INCREASE IN STATURE BETWEEN THE FOLLOWING YEARS:

	6 and 7	7 and 8	8 and 9	9 and 10	10 and 11	11 and 12	12 and 13	13 and 14	14 and 15	15 and 16
Short boys	5.5	5.2	4.8	4.8	4.8	4.8	5.2	7.3	7.5	6.8
Tall boys	5.9	5.5	5.0	5.4	5.3	5.2	6.6	8.5	5.0	4.4
Difference	+0.4	+0.3	+0.2	+0.6	+0.5	+0.4	+0.6	+1.2	—2.5	—2.4
Short girls	5.7	5.5	5.3	5.5	5.8	7.0	7.4	6.5	4.5	
Tall girls	6.1	5.9	5.6	6.4	6.5	7.0	6.0	4.4	2.2	
Difference	+0.4	+0.4	+0.3	+0.9	+0.7	0.0	—1.4	—2.1	—2.3	

It appears that during the early years of childhood short children grow more slowly than tall children, that is to say their general development continues to be slow. Later on, during the period of adolescence, they continue to grow while tall children have more nearly reached their full development. That is to say, small children are throughout their period of growth retarded in development, and smallness at any given period as compared to the average must in most cases be interpreted as due to slowness of development. During early life slowness of development which has manifested itself is likely to continue, while some of the effects of retardation will be made good during the period of adolescence, which is liable to be longer than in children who develop rapidly in early life.

We will call the average stature at the age t A_t; the amount of growth of an individual whose stature at that period is $A_t + x$ may be called d_x. We assume that the relation between the actual size of an individual and the average amount of its annual growth be expressed by the simple relation

$$d_x = d + ax$$

where a is a constant.

Furthermore we will assume that the variability of d_x will be the same for all values of x. Then it can easily be proved that

$$a = \sqrt{\frac{\mu_1^2 - m^2}{\mu^2}} - 1$$

where μ and μ_1 the variabilities of stature at the periods t and t_1 and where m the variability of the amount of growth during the period t_1–t.

From these data the following values of a have been computed:

Age.	Boys.	Girls.
6	0.05	0.05
7	0.05	0.05
8	0.01	0.01
9	0.03	0.03
10	0.06	0.06
11	0.06	0.07

Age.	Boys.	Girls.
12	0.10	−0.11
13	0.08	−0.17
14	−0.03	−0.20
15	−0.22	

The values cannot claim any great weight, since the series of observations is very small. Only about fifty individuals for each year and sex are available. They prove, however, that the values of a first decrease until about the eighth year. Then they increase and decrease again very rapidly after the thirteenth year in boys and after the eleventh year in girls.

According to the assumptions made before, the average individual which measured $A + x$ at the period t will measure

$$(A + x) + (d + ax) = A + d + x\frac{\mu_1}{\mu}\sqrt{1-\frac{m^2}{\mu_1^2}}$$

at the period t_1.

If it measured

$$A + d + x\frac{\mu_1}{\mu},$$

it would remain in the same percentile grade while according to the above formula its percentile standing will be nearer the average than at the initial period t. Only when all the children of the initial measurement $A + x$ grow equally, *i. e.*, if $m = 0$ could they remain in the same percentile grade. This conclusion agrees with Dr. Henry G. Beyer's observations.*

The above approximation is fairly satisfactory during the early years of childhood. During the period of adolescence it is not satisfactory, because the values of a are too large. More extended observations will enable us to include terms of higher order in the considerations and to obtain more accurate knowledge of the laws of growth.

The results of this investigation suggest that the differences of growth observed in children of different nationalities and of parents of different occupations may also be partly due to retardation or acceleration of growth, partly to differences of development in the adult stage.

In order to decide this question we may assume that in the averages obtained for all the series representing various social groups accidental deviation from the general average only occurred. Then it is possible to calculate the average deviation which would result under these conditions. When the actual differences that have been found by observation are taken into consideration another average deviation results. If the latter nearly equals the former, then the constant causes that affect each social group are few and of slight importance. If it is much larger than the former, then the causes are many and powerful. The proportion between the theoretical value of the deviation and the one obtained by observation is therefore a measure of the number and value of the causes influencing each series.

I have applied these considerations to the measurements of Boston school children obtained by Dr. H. P. Bowditch. I have used thirteen different classes in my calculations, namely, five nationalities: American, Irish, American and Irish mixed, German and English; and eight classes grouped according to nationalities and occupations: American professional, mercantile, skilled labor and unskilled labor, and the same classes among the Irish.

The results are as follows:

	Boys. Deviation.			Girls. Deviation.		
Age.	Theory.	Obs.	Ratio.	Theory.	Obs.	Ratio.
5	0.34	0.34	1.0	0.40	0.58	1.5
6	0.28	0.46	1.6	0.34	0.57	1.8
7	0.29	0.76	2.6	0.32	0.81	2.5
8	0.28	0.54	1.9	0.30	0.71	2.4
9	0.32	0.89	2.7	0.36	0.40	1.1
10	0.33	0.76	2.4	0.38	0.83	2.1
11	0.35	1.05	3.0	0.46	1.04	2.2
12	0.40	1.18	3.0	0.52	1.89	3.6
13	0.46	1.65	3.6	0.52	1.44	2.8
14	0.57	2.69	4.7	0.53	0.98	1.9
15	0.67	2.06	2.9	0.53	1.02	1.9
16	0.72	1.50	2.1	0.54	0.53	1.0

* Proc. U. S. Naval Institute, Vol. XXI., No. 2.

We see that the values obtained by actual observation are always greater than those obtained under the assumption that only accidental causes influence the averages for each class. We also see that these causes reach a maximum during the period of growth and decrease as the adult stage is reached. The maximum is found in the fourteenth year in the case of boys, in the twelfth year in the case of girls, *i. e.*, in those years in which the effects of acceleration and retardation of growth are strongest. Although the values given here cannot claim any very great weight on account of the small number of classes, this phenomenon is brought out most clearly.

The figures prove, therefore, that the differences in development between various social classes are, to a great extent, results of acceleration and retardation of growth which act in such a way that the social groups which show higher values of measurements do so on account of accelerated growth, and that they cease to grow earlier than those whose growth is in the beginning less rapid, so that there is a tendency to decreasing differences between these groups during the last years of growth.

FRANZ BOAS.

THE PROMISE AND POTENCY OF HIGH-PRESSURE STEAM.

THE writer has been so fortunate, recently, as to be permitted to study the action of exceptionally high-pressure steam in the engine, under favorable conditions, and thus to add to the record of Jacob Perkins and his sons, and of Dr. Albans and others experimenting with steam of extraordinarily high-pressure, data which represents much more satisfactorily the conditions now known by the engineer to be those essential to economic operation.*

The progress made to date and during the century now elapsed since the introduction by James Watt of the modern type of steam-engine, as adapted to the performance of every variety of work, has been mainly through the steady advances effected in the successful management and application of steam of increasing pressure, with corresponding thermodynamic gain by increasing the ratio of expansion, and with reduction of wastes, mainly by increasing speeds of engine. The accessory gains have been through expedients for improving the lubrication, to reduce wastes of dynamic energy, and for securing better protection against external losses of thermal energy, and improvements, as by jacketing and superheating, resulting in suppression of the internal condensation, due to the action of the cylinder wall.

Increasing steam pressure gives increased mean effective pressures, and rising temperatures of steam afford gains by widening the range of adiabatic and thermodynamic transformation of energy. Superheating has not, as yet, been successfully carried so far as to permit increased thermodynamic transformation by providing a steam gas as the working fluid in the engine. It practically simply insures dryer, and thus better, working steam. Up to the present time the risings, temperatures and expansions have gone together, being limited by the conditions which give us dry and saturated steam. The result has been a steady advance for a century, both in the 'duty' of the machine and its complementary elements, thermodynamic and mechanical efficiency. Watt insisted on restricting steam pressure to seven pounds per square inch on the score of safety; we now employ from twenty to thirty times that pressure with probably no greater risk. The work described in the communication here abstracted was done at 300 to 500 pounds pressure, and the boiler employed had been

* The 'Promise and Potency' of high-pressure steam; illustrated by the performance of the triple, and the quadruple-expansion experimental engines of Sibley College. Trans. Am. Soc. M. E., December, 1896. Vol. XVIII; No. DCCXVIII.

tested up to 1,350 pounds and operated, with the engine, at times, at above 600 pounds pressure. But even these working pressures are comparatively low figures beside those of Perkins, who sixty years ago operated steam engines at 1,000 and 1,500 pounds and upward, and whose disciple, Dr. Albans, built a number of engines for regular work at nearly as great tensions of steam. Owing to their incomplete expansion, and owing to the fact that they were not compounded or otherwise insured against great 'cylinder condensation,' the engines of neither of these experimentalists attained what would be to-day thought remarkable economy. It was, however, remarkable for their time.

In those early days a piston speed of '128 times the cube root of stroke' was standard practice; the figure has now risen to, in some instances, four times this figure, and standard practice ranges from 600 feet, with small 'automatics,' to 1,000 feet per minute in large engines. The size, weight and cost of the machine for any stated power have been correspondingly diminished. The main source of gain in the meantime has been the diminution of the internal thermal wastes of the machine, which constituted in the days of Watt ninety per cent. or more of the demand for steam in the old Newcomen engine which he reconstructed, thirty to forty per cent. of the steam consumption in his own engines, and which has now fallen in the best contemporary machines to about twenty per cent., still constituting an important source of loss. 'Duty' has risen from about 10,000,000 foot-pounds in the first of these series to 60,000,000 in the second, and has attained to-day about 150,000,000 and promises to become 160,000,000 at the end of the century, per hundred pounds of best coal consumed. Reduced to steam consumed, the latter figures correspond to about eleven and a-half and about eleven pounds per horse-power per hour, and, in heat expended, about as many thousand B. T. U., with high temperature feed-water with large proportion, or ten per cent. more with moderate admixture, of jacket water. In fuel, it corresponds to from $1\frac{1}{4}$ to $1\frac{3}{4}$ pounds per I. H. P. per hour. The average steam engine of even good makers seldom attains much more than one-half the efficiency of the modern record-making machines.

The triple-expansion engine of Sibley College, built and employed as an experimental engine purely, illustrates the action of good engines at about 125 pounds pressure (absolute). It gives the indicated horse power on about 13.3 pounds of steam, 15.1 per D. H. P., and 14,160 B. T. U. per hour; its total ratio of expansion being 13.83, and the jackets supplying 13.72 per cent. of the feed water. The thermodynamic efficiency of the corresponding Carnot Cycle would be 24.7 per cent.; that of the engine is 18 per cent. A low vacuum, 22 inches, makes this work still more remarkable for so small an engine. It operated at 140 I. H. P. in this case. The machine was built for 175 pounds steam—another disadvantage. The dictum of Dwelshauver-Dery and the writer, that the jackets produce best effect, and efficiency attains a maximum, when the expanding steam is dry at or before final exhaust into the condenser, is confirmed by these results. The jackets are in this engine always advantageous.

The records first given, as the present maxima, are from large engines operated at from 125 to 175 pounds pressure. Those are triple-expansion. The following are data relating to the quadruple-expansion experimental engine of Sibley College, Cornell University, operated at, in some cases, 500 pounds pressure and upward. The machine is of but twenty horse-power rating; its cylinders having diameters of respec-

tively 2.344, 3.969, 6.977 and 10.266 inches; the stroke of piston being 4.5 inches, and its speed of revolution usually about 300 per minute. The engine possesses a number of interesting and ingenious new devices introduced by its designers and builders, Messrs. Hall and Treat, graduate students of the College; and its boiler, a water-tube construction, is also original in plan.

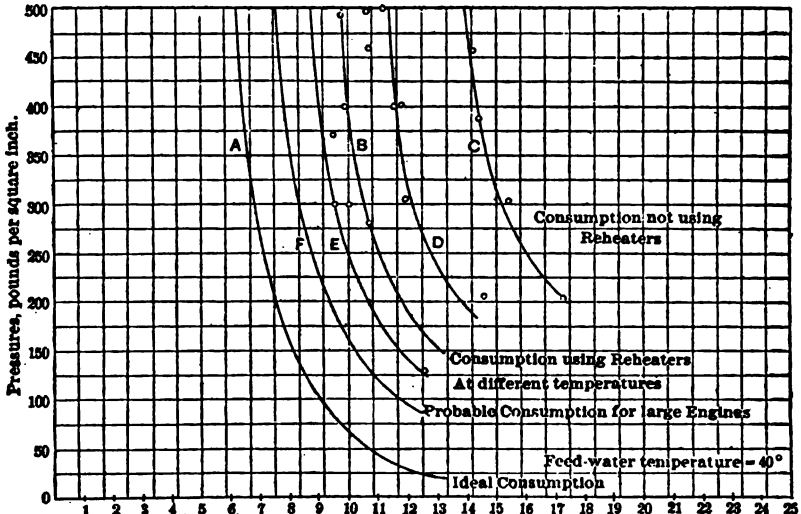
The trials of this engine, conducted under many difficulties, and often at some hazard, in consequence of perpetual trouble met with, in the early part of its history, in securing a reliable means of feeding against the high boiler-pressure, and in finding a good method of obtaining water-level indications, resulted in showing an exceedingly low steam and heat consumption. After a good feed pump had been secured, and the boiler could be handled with safety and without anxiety, and after the constructors had devised a new and reliable system of water-level indication, trials were carried on, the outcome of which has now been published. The net result was the indication of a pressure of maximum efficiency, for this engine, less than that for which it was designed, and the obtaining, at best adjustments, of an efficiency of about thirty per cent., a steam consumption of about ten pounds per I. H. P. per hour, and of 226 B. T. U. per I. H. P. per minute, 13,560 per hour, at 300 and 400 pounds pressure. The engine was provided with 'reheaters,' or drying chambers, between each pair of cylinders, and, these being thrown out and the steam worked wet, the consumption rose to from 13.7 pounds at 500 pounds pressure to 15.5 at 300 pounds, per I. H. P. per hour. The wastes in the latter case were substantially the same at high as at low pressures, and the deduction follows that we may expect at high steam pressures about as close an approximation to the ideal thermodynamic case as at ordinary tensions of steam. There still remains, however, some question as to the exact efficiency of even this engine; owing to irregularity and shortness of most of the trials, due to the difficulties with the boiler above mentioned, and some uncertainty regarding leakage past piston and valves; the existence of which is at least indicated by the measurements of the indicator diagrams.

A comparison of these figures with those of larger engines in commercial use can only be made after allowing for the comparatively large internal wastes, due to the excessive proportion of area of cylinder wall to weight of steam passing through the engine, in the case of small machines. Reducing these wastes by any probable fraction, the heat, steam and fuel consumption of the engine at its regular pressure, above thirty-three atmospheres, would give a consumption of not far from $7\frac{1}{2}$ pounds of steam per I. H. P. per hour, or from 7,500 to 8,000 B. T. U., according to temperature of feed water.

The diagram herewith presented shows the relation of the efficiency of the ideal, purely thermodynamic, engine of similar cycle—the Rankine form—to the actual performance. The curve A is that of the best ideal, case B that of the average best performance of the experimental engine, C that with its reheaters out of use, and the various observations indicated on the chart show the variations due to varying efficiency of reheating and to other variable conditions of operation. D may be taken as representing fair average performance, and E the limit of best work; while F is not far from what should be expected from large engines of similar type, and is taken as representative of the commercial attainable performance of such good practice at 500 pounds pressure and under.

These curves of relation of steam used to power produced are of the form

$$w = a / \log p;$$



—Efficiency Curves, Ideal and Actual.

where the value of a varies from 18 on the line A, to 25 on B, 30 on C, and to 22 and 24 on lines F and E; w being weight of steam per h. p. per hour, p steam pressure.

Of the figures representing efficiency, as here recorded, it is probable that those on the line C may be accepted as accurate. Those obtained with reheaters in use are obviously less certain, and may be subject to some error. On the whole, the writer considers that the assignment of the lines E and F as those to be attributed to successful practice with large engines, and as representing the 'promise and potency' of high-pressure steam, is well justified.

R. H. Thurston.

Cornell University.

THE ORIGIN OF THE TEETH OF THE MAMMALIA.

Professor H. G. Seeley, F.R.S., in a series of memoirs in the *Philosophical Transactions*, during the past three or four years, has been describing the Upper Triassic vertebrates of South Africa. Certain of these animals are upon the border line between the Reptiles and Mammals, and, as Professor Seeley points out, show a most remarkable intermingling of characters. The cranial characters, with the exception of the paired occipital condyle, are mainly reptilian; the dental characters, and this is the point to which I wish to especially draw attention, are pro-mammalian. The point of particular interest is that within this group are found *all the primitive mammalian types of teeth*. *Lycosaurus* is haplodont; *Galesaurus Cynognathus*, both members of the *Cynodontia* or Carnivorous division, are *triconodont*. The teeth are as clearly divided into incisors, canines, premolars and molars as those of the lower Jurassic mammals. The dental formula approximates that of the stem mammal. These animals parallel or are actually related to the great 'protodont-triconodont-trituberculate' phylum of mammalia, which includes the Marsupials and Placentals. In a distinct division of herbivorous reptiles, which Seeley terms the *Gomphodontia*, we find a corresponding parallel or ancestral relation to the 'multituberculate' phylum of mammals, including the Multituberculata and possibly the Monotremata. Here, in fact, actually belongs *Tritylodon*, which upon good grounds has, until recently, been considered a multitu-

berculate mammal. The teeth of *Diademadon* show an incipient division of the fang and closely resemble in the crown the alleged *Microlestes* of the Rhætic of Germany. The point of additional interest is in the superior molars of an allied form, *Gomphognathus*. These are, as Professor Seeley implies, multitubercular, but they are also *tritubercular* in pattern. It is difficult to resist the inference that the four upper cusps do not represent the protocone, paracone, metacone and hypocone. If this is supported by further discoveries it will amply demonstrate the truth of the hypothesis which I have long advocated, that multitubercular teeth are more or less degenerate derivatives of tritubercular teeth.

HENRY F. OSBORN.

MARCH 25TH.

ZOOLOGICAL NOTES.

THE SHARP-TAILED FINCHES OF MAINE.

IN the proceedings of the Portland Society of Natural History (Vol. II., March 15, 1897) Mr. A. H. Norton remarks on the distribution and relationship of the sharp-tailed finches of Maine.

He states that *Ammodramus c. subvirgatus* breeds in the swale-bordered tide rivers, in close proximity to rocky bluffs fringed with black spruce, while true *caudacutus* of southwestern Maine rears its young in the broad salt marshes along the sandy beaches. As there are none of these low marshes in the area inhabited by *subvirgatus*, it necessarily takes the only available nesting grounds; consequently the difference in the character of the home of the two birds is of no apparent significance. It is suggested that after the close of the glacial epoch *subvirgatus* followed up the receding ice until a barrier to the bird's northward migration was reached at the Gulf of St. Lawrence. From this point the overflow of individuals pressed westward along the Great Lakes and finally covered the area now occupied by *nelsoni*.

The author, in common with a few others, is of the opinion that *A. caudacutus* and *A. nelsoni* are specifically distinct, and that *subvirgatus* is a race of the later so-called species. In this we do not agree, and would consider it just as logical to separate *Melospiza fasciata* and *M. fallax* into species with *montana* as a race of the latter bird.

A. K. FISHER.

CURRENT NOTES ON PHYSIOGRAPHY.

YELLOWSTONE NATIONAL PARK.

THE Yellowstone folio of the Geologic Atlas, by Hague, Weed and Iddings, forms No. 30 of the series. It has six pages of text, three plates with eleven admirably reproduced photographs, four topographic and four geologic sheets; all at a cost of 75 cents. Apart from the wonders of the geysers, the plateaus of lava beds and volcanic breccias, deeply dissected, especially in the Absaroka range, along the eastern border of the Park, are most notable. The slender, digitate forms of some of the ancient plateau remnants are remarkably well displayed on the topographic sheets. The continental divides in two open valleys that trench across Two-ocean plateau are peculiar, one of them being the famous Two-ocean pass, where a stream from the north forms a fan at the summit of the pass, turning its water rather indifferently to Atlantic Creek on the east or to Pacific Creek on the west. The origin of this deep and rather wide valley through the plateau is not stated, and our curiosity is left unsatisfied as to the reason why the Yellowstone River, with its relatively mature and open headwater valleys, has cut a distinctly young, steep-sided canyon in its more northern course.

BEARPAW MOUNTAINS, MONTANA.

MESSRS. Weed and Pirsson describe the Bearpaw mountains of Montana (Amer. Journ. Science, I., 1896, 283–301, 351–362)

as the dissected remains of a group of Tertiary volcanoes. Seen from the surrounding plains, the mountains have a serrate outline, highest near the center of an oval area, 20 by 40 miles in diameter. Seen in plan, they exhibit a well defined system of radial valleys. The interstream peaks and ridges consist of volcanic tuffs, breccias, and flows, lying on Cretaceous strata, around a central district of laccolitic cores, dikes and bosses. The Cretaceous strata are somewhat upturned and baked around the largest laccolitic mass, and the 'contact ring' stands in bold relief, forming ridges around the igneous center.

In the absence of detailed surveys of this region, a somewhat similar type may be studied on the topographical and geological maps of the great dissected volcano, known as the Cantal, on the central plateau of France.

LAURENTIAN HIGHLANDS OF CANADA.

A REPORT by Professor F. D. Adams on the geology of a portion of the Laurentian area (Geol. Surv. Canada, VIII., 1896, pt. J) includes a brief account of the physical features of an area lying northwest of Montreal. Leaving the drift-covered valley of the St. Lawrence, underlain by paleozoic strata, the Archæan highlands rise abruptly in a line of hills, which constitute the edge or southerly limit of a great uneven plateau, gradually rising to the northwest. Its surface is undulating or mammilated; the depressions being generally filled in with drift, forming extensive flats, studded with numerous lakes, great and small. Rounded, ice-worn bosses or hills protrude through the drift, seldom rising more than three or four hundred feet above the general level, and presenting, especially when burnt over, great faces or whole summits of bare rock. The lake outlets have carved terraces in the drift-clogged valleys. Settlements are scattered over the drift plains, avoiding the rocky hills.

The date of origin of the undulating plateau is not considered; but Lawson's supposition that it is a pre-paleozoic land surface, long preserved by burial, and lately revealed by the erosion of its cover—a geographical fossil, as it were—seems to be contradicted by the well defined line of bluffs in which the Archæan rises from the St. Lawrence valley, unless this line is determined by an unmentioned fault.

MAPS OF MT. DESERT.

MESSRS. Bates, Rand and Jaques have rendered a service to the summer residents of Mt. Desert by publishing several good maps of the island; one on a scale of 1:40,000 (in a single sheet or folded in cover), another on a scale of 1:25,000 in two large sheets, and a third of Bar Harbor, on a still larger scale. All have contour lines, the first two printed in brown with the culture in the black and the water in blue. A special map of the eastern part of the island shows the mountain paths in red. All the maps are based on the Coast Survey sheets; but the names are carefully revised to accord more closely with local usage, the revision and republication being the outcome of a careful work on the Flora of Mt. Desert by Mr. E. L. Rand and collaborators. Any of the maps can be had of Mr. Waldron Bates, 40 Water street, Boston. To the more observant of the island residents, winter or summer, these maps would serve as a good base for detailed record of the supposed high-level shore lines, described by Shaler.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE PROGRESS OF ANTHROPOLOGY.

THE President of the Anthropological Institute of Great Britain, Mr. E. W. Brabrook, in his annual address in January last, re-

viewed the advance of the science during the past year. He pointed out the constantly accumulating evidence to the continuity of human culture from the earliest period, and the growing certainty that the progress of the race has been constant. The importance of establishing an ethnographic bureau for the United Kingdom, analogous to our Bureau of Ethnology, was strongly emphasized, and the progress of the Ethnographic Survey was mentioned in complimentary terms. His closing remarks on 'The Problem of Transmission' are as follows:

"It has appeared to me that there is, in the minds of anthropologists, a growing tendency to discountenance inquiries into transmission, and to consider phenomena related to a particular stage of civilization arrived at by the operation of general laws, rather than as arising from communication between the people."

There is no doubt of this.

THE LUMBAR CURVE.

THE study of the lumbar curve as a point in comparative ethnic anatomy has received some attention from somatologists, but the first examination of it among the native American tribes is that by Dr. George A. Dorsey, in the Bulletin of the Essex Institute, Vol. XXVII. His specimens were drawn from tribes of the northwest coast, the Iroquois, the Ohio mounds and Peru. His conclusions are that the index of the curve is an important means of determining sex and that "it bids fair to become one of the most valuable ethnic tests known in determining the physical superiority or inferiority of any tribe or race."

Dr. Dorsey's tables and measurements are most carefully presented, and the subject is set forth with great clearness. It would appear, however, from the remarks of Cunningham which he quotes (p. 59) that these variations are due largely to habits of life, and if so this index could be only a secondary ethnic test, as such habits vary so widely in the same community.

NATIVE AMERICAN MYSTICISM.

A SYMPATHETIC but far from exhaustive study of this subject has lately appeared from the pen of Dr. L. Kuhlenbeck (Der Occultismus der nord-amerikanischen Indianer,' pp. 60, Leipzig, W. Friedrich). He points out, with entire correctness, that not only the religious observances, but the actions of the social and individual life among the Indians are constantly guided by spiritual agencies or occult forces. He compares their mental position in this respect with that of Goethe, who, in his conversations with Eckermann, so often referred to the 'demonic' powers which control events—surely an honorable comparison.

The author analyzes the mental experiences of the 'medicine men,' and quotes a number of instances of their strange powers and the processes by which these are acquired. Though the essay is lacking in the critical caution desirable in treating so obscure a subject, it is suggestive and composed in an appreciative spirit.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR J. WILLARD GIBBS, professor of mathematical physics at Yale University, has been elected a foreign member of the Royal Society.

M. BONNIER has been elected member of the section of botany of the Paris Academy of Sciences in the room of the late M. Trécul, receiving 42 votes of the 57 cast.

THE portrait of Lord Lister, painted by Mr. W. W. Ouless, was presented to the Royal College of Surgeons on March 29th.

IT is proposed to celebrate the sixtieth anniversary of Sir George Stokes' connection with the University of Cambridge by the presenta-

tion of a bust to be executed by Mr. Thornycroft. Sir George Stokes has for nearly fifty years been Lucasian professor of mathematics in the University.

THE bust of Sir Henry Acland, formerly Regius professor of medicine at Oxford, has been placed in the court of the University Museum.

SIR WILLIAM DAWSON the eminent geologist, late principal of McGill University, and Lady Dawson celebrated their golden wedding on March 19th.

THE library of the German Astronomical Society has been purchased by a number of citizens of Bamburg and presented to the observatory.

MR. HENRY M. PAUL, assistant astronomer at the U. S. Naval Observatory, and Mr. George A. Hill, computer in the office of the *Nautical Almanac*, have been appointed professors of mathematics in the navy.

THE members of the New York Zoological Society have learned, with regret, of the death of Dr. A. A. van Bemmelin, late director of the Zoological Garden of Rotterdam. Besides the loss to zoological science in general, his death is a loss to the New York Zoological Park in particular. From the inception of that enterprise Dr. van Bemmelin responded most heartily to all calls made upon him for information and advice, and forwarded to the Society many closely-written pages of details regarding the status of the garden that has been developed so successfully under his direction. Although the Rotterdam garden is not quite so large as some of the other European gardens, it is very beautiful and attractive, and the highest praise that could be bestowed upon Dr. van Bemmelin is found in the statement that for more than twenty years he has been its director. The first of the four great flying cages in Europe is the one designed and constructed by him. The most recent lion house in Europe is the one erected by the Rotterdam society, under his direction, in 1894.

THE funeral of Professor Sylvester took place on March 19th at the cemetery of the West London Synagogue of British Jews. The Royal Society and the London Mathematical Society were represented by Professor Michael Foster, Major Macmahon, Professor Forsyth, Professor Elliott, Dr. Hobson, Professor Greenhill, Mr. A. B. Kempe and Mr. A. H. Love.

WE regret to announce the deaths of Dr. Joseph F. James, known for his writings in paleontology, botany and geology, who died of pneumonia at Hingham, Mass., on the 29th of March; of M. Antoine T. d'Abbadie, sometime President of the Paris Academy of Sciences, known for his works on geographical exploration and on geodesy; of Dr. Robert Hogg, the horticulturalist; of Mr. John Biddulph Martin, President of the Royal Statistical Society; of M. C. Contejean, of the Pasteur Institute, and of C. F. Wiepken, for sixty years director of the Oldenburg museum.

WE learn from *Nature* that a meeting of presidents of various scientific societies in London was recently convened by the President and officers of the Royal Society to consider whether any, and if so what, steps should be taken to commemorate the sixtieth year of Queen Victoria's reign. It was unanimously resolved "That a fund to be called the Victoria Research Fund be established, to be administered by representatives of the various scientific societies, for the encouragement of research in all branches of science." The President of the Royal Society has communicated this resolution to the scientific societies, with a letter asking whether support would be given to it.

IN addition to the nominations made by the Council of the British Association for presidents of the different sections at the forthcoming meeting at Toronto, announced in the issue of SCIENCE for February 12th (p. 251), Mr. J. Scott Keltie has been nominated as president of the geographical section. Evening lectures will be given by Professor Roberts-Austin and Professor John Milne.

THE Museums Association of Great Britain meets this year at Oxford, from June 29th to July 2d, under the presidency of Professor Ray Lankester. Men of science wishing to attend or present papers should apply to the secretaries, H. M. Platnauer, the Museum, York, and E. Howarth, the Museum, Sheffield.

THE eleventh annual meeting of the German

Society of Anatomists will be held at Ghent from April 24th to 27th, under the presidency of Dr. Waldeyer.

IT is stated in *Nature* that the Comité d'Organisation of the seventh International Geological Congress, to be held at St. Petersburg from August 29th to September 4th, have received so many applications from persons who are not geologists, and yet wish to obtain free railway tickets and to participate in other advantages arranged by the Russian government, that they have issued a special circular stating that the facilities offered are intended only for geologists. Excursion tickets will only be granted to persons who are known by their contributions to geology. Even with this restriction, the meeting promises to be a large one, for more than six hundred geologists have applied for tickets.

THE American Medical Association will meet in Philadelphia, beginning on June 1st. The American Medical Publishers' Association meets on the preceding day. There are said to be published in America 275 medical journals, of which 10 are issued weekly, 11 semi-monthly, 225 monthly, 6 bi-monthly, and 23 quarterly.

ACCORDING to the New York *Medical Record* the next course of ten lectures instituted by the late Professor Thomas Dent Mütter, M. D., LL. D., on 'Some Point or Points in Surgical Pathology,' will be delivered in the winter of 1899–1900, before the College of Physicians of Philadelphia. The compensation is $600. The appointment is open to the profession at large. Applications stating in full subjects of proposed lectures must be made before October 1, 1897, to the committee on Mütter Museum, John H. Brinton, M. D., chairman, northeast corner of Thirteenth and Locust streets, Philadelphia, Pa.

THE John Crerar Library of Chicago was opened to the public on April 1st. It will occupy rented rooms until the accumulated income from its endowment, which is $2,500,000, will suffice to pay for the erection of a building. The library is devoted especially to the natural, physical and social sciences and their applications.

IT is expected that the New York Legislature will pass the bill recommended by Governor Black appropriating $1,000,000 for the preservation of the Adirondack forests.

MR. FRYE has introduced a bill in the Senate creating a National Academy. The bill provides that the Academy shall be devoted to the accumulation and preservation of new discoveries and the perfection of the arts and sciences. The Academy would have five divisions: First, laws and literature; second, inscriptions, archæology and belles-lettres; third, sciences; fourth, fine arts; fifth, moral and political science. The Academy would have one hundred members and fifty foreign associate members, and in addition 100 American and 200 foreign corresponding members.

A NATIONAL German exhibition 'For the Hygiene of Childhood at Home and at School' is to be held in Breslau at the end of May.

THE following items are taken from *Natural Science*: The collections of Gustav Nachtigal from the west coast of Africa, made during 1894–95, are now exhibited in the Berlin Museum of Ethnology. The Berlin Museum für Naturkunde has received from the island of Ralum a collection of the flora and fauna made by Dr. Dahl. Mr. H. J. Ernst, an apothecary of Iceland, has presented to the State Museum in Stockholm a valuable collection of Icelandic minerals. Mr. and Mrs. Theodore Bent, the archæological explorers, have returned from a successful expedition in Socotra. Mr. J. Whitebeard has been investigating the highland fauna of the Philippines, where he obtained a huge fruit-pigeon at a height of 6,000 feet. Mr. C. W. Andrews, of the geological department of the British Museum, has received leave of absence for nine months in order to investigate the natural history of Christmas Id.

THE Director of the United States Geological Survey has just addressed to the geologists, the topographers and all authors in the Survey a circular on the use of 'Quadrangle,' the new designation for the quadrilateral land units of the government surveys. In prosecuting the topographic and geologic survey of the United States the Geological Survey divides the land into small quadrilateral units, bounded by meridians and parallels, and from these result

atlas equivalent sheets, the paper dimensions of which are 20 by 16½ inches. The map units, the director explains, are appropriately called *sheets*, but no name has been uniformly applied to the land units, in the way, for example, in which *section* is used in the nomenclature of the General Land Office. The custom has arisen of applying the name *sheet* to the land unit also. The geologist and topographer ordinarily speak of surveying a 'sheet.' This usage is objectionable for obvious reasons. Hereafter, therefore, according to the new practice, the word *sheet* will be restricted to the designation of the map unit. Whenever the land unit, strictly speaking, *i. e.*, a quadrangular portion of the earth's surface delimited by the meridians and parallels of an atlas sheet, is referred to, the word *quadrangle* will be used (*e. g.*, 'In the southeastern corner of the quadrangle'); and in those cases where a word is desirable which does not connote definite demarcation, or which more strongly connotes land, the word *district* will be used (*e. g.*, 'The investigation of the district'). The use of these two words (*quadrangle* and *district*) in any other connection is to be avoided, recourse being had to the various synonyms, such as area, tract, region, territory, etc. The definite usages proposed will doubtless be a decided gain for clearness and uniformity.

Mr. Wolcott, of Colorado, has presented in the United States Senate a memorial from the Legislature of Colorado praying for a generous provision to enable the United States Geological Survey to continue and extend the examination of the metalliferous districts of the States and Territories and to carry forward the needed surveys. Provision is also urged for the prompt publication of the Survey's work, much of the work depending for its value upon early publication. There is a strong feeling, especially throughout the mining regions of the country, that the government should do more for the survey of the mining districts and the devlopment of the mineral resources, as is evidenced by the various propositions that were presented at the last regular session of Congress. Though much of the work of the Survey has been rendered less useful by delays in publication, the past two or three years have witnessed a marked improvement in this regard. A number of recent publications have been published with gratifying promptness, notably among them being the Seventeenth Annual Report of the Director, just issued.

We have received several further replies from scientific instrument makers in regard to the imposition of a tax on scientific instruments imported for educational institutions. Mr. J. G. Gray, President of Queen & Co., Philadelphia, writes that "it is possible from a narrow point of view that the proposed abrogation of the duty-free clause in the tariff law might benefit makers of apparatus in the United States." "But from the broader standpoint of the welfare of educational institutions in general and the advancement of science, it would be a retrograde step and a serious misfortune if it should become impossible to import free of duty, for the use of such institutions, the class of instruments and apparatus which they are now accustomed to import. Whilst we are manufacturers, we cannot but recognize that the narrow and possibly supposed interest of a few makers of scientific apparatus should not weigh against the wider and unquestioned interests of those engaged in education and original research and whose labors return many times over to the commercial community any advantage which may be granted them."

Charles Scribner's Sons have in press a work on *Philosophy of Knowledge*, by Professor G. T. Ladd, Yale University, which will be of interest both to men of science and to students of philosophy. The subjects treated may be seen from the titles of the chapters, which are as follows: I., The Problem; II., History of Opinion; III., History of Opinion (continued); IV., The Psychological View; V., Thinking and Knowing; VI., Knowledge as Feeling and Will; VII., Knowledge of Things and Knowledge of Self; VIII., Degree, Limits and Kinds of Knowledge; IX., Identity and Difference; X., Sufficient Reason; XI., Experience and the Transcendent; XII., The 'Implicates' of Knowledge; XIII., Scepticism, Agnosticism and Criticism; XIV., Alleged 'Antinomies;' XV., Truth and Error; XVI., Ethical and Æsthetical 'Momenta;' XVII., The Teleology of Knowledge; XVIII., Knowledge and Reality;

XIX., Idealism and Realism; XX., Dualism and Monism; XXI., Knowledge and the Absolute.

NEW volumes in the Contemporary Science Series, edited by Mr. Havelock Ellis and published in England by Walter Scott and in America by Charles Scribner's Sons, will include 'The New Psychology,' by Dr. E. W. Scripture; 'Psychology of the Emotions,' by Professor Th. Ribot, and 'Hallucinations and Illusions,' by Mr. E. Parrish.

THE California Academy of Sciences announces important changes in its publications. In addition to occasional extended monographs, the proceedings will be issued in several wholly independent divisions or parts; each division to be devoted to a single branch of science, or to a group of closely related sciences. There will be begun at once three divisions, viz.: for geology, for botany and for zoology, and from time to time such others as may be demanded, and as the finances of the Academy will permit. It is probable that a mathematico-physical division will be added in the near future. Papers will be issued separately and will be distributed immediately. Each title page will bear date of issue and the number in the volume of the division to which the paper belongs. The divisions will be formed in volumes, chiefly according to convenience, and with but incidental reference to time, each volume containing generally about 400 to 500 pages. The Publication Committee, charged with the general supervision of all publishing done by the Academy, consists of Professor William E. Ritter, Chairman, first Vice-President of the Academy; President David Starr Jordan, President of the Academy, and Mr. G. P. Rixford, Recording Secretary. This committee will be supplemented by editorial committees in the different departments, as now constituted, Professors Andrew C. Lawson and James Perrin Smith in geology, Professors W. R. Dudley and W. A. Setchell in botany, and President David Starr Jordan and Professor William E. Ritter in zoology. We find in the recent proceedings of the California Academy very important contributions to our knowledge of the fauna, flora and geology of the Pacific Coast, and the subjects on which papers are expected in the near future show great activity in scientific research in California.

ACCORDING to the London *Times* Mr. H. N. Thompson, Assistant Conservator of Forests in Burma, in a recent report on the forests of the Hukong valley and the Upper Namkong basin, in Upper Burma, devotes a section to the production of rubber in that region. It appears that in the Hukong valley the rubber tree is not a gregarious one; sometimes a family group of four or five trees may be seen, but, as a rule, a mature tree is found every 200 or 300 yards in the richer forests. When the tree is surrounded by dense shade it grows to enormous heights in order to get at the light, and some of those examined by Mr. Thompson were the largest trees of any species he had ever seen. In the thick forest he found no seedlings in the ground; they were invariably growing at a great height on other trees and sending their roots down towards the ground, so that the roots finally formed great supports on which the main trunk rested, while the original tree, on which the seedling was a parasite, was destroyed.

REUTER'S agency reports that the Egyptian Council of Ministers has approved of the appointment of Professor Forbes, the electrician, to examine the Nile cataracts and prepare an exhaustive report regarding the best methods of utilizing the water power available for generating electricity. Professor Forbes will commence his studies in the autumn.

THE report of the Meteorological Council to the Royal Society for the year ended March 31, 1896, has been issued as a Blue-book. We learn from the London *Times* that the report is divided into four sections: (1) Ocean Meteorology, (2) Weather Telegraphy, (3) Climatology, and (4) Miscellaneous. With respect to weather telegraphy and forecasts, it is stated that the daily weather report appeared regularly, and there was a regular display at the Meteorological Office in London of the state of the weather on British coasts. It is stated that of the total number of forecasts 55 per cent. were complete successes, 25 per cent. partial successes ('partial' meaning 'more than half') 14 per cent.

partial failures, and 6 per cent. total failures. The total percentages of successes was therefore 80. The total amount voted by Parliament during the year was £15,300, and £769 became available in addition. The expenditure was £15,187, showing a decrease of £25 as compared with 1894–95.

UNIVERSITY AND EDUCATIONAL NEWS.

It is reported in the daily papers that the subsidy given by the state to the University of California will be doubled, being hereafter $240,000 annually. Mr. Levi Strauss, of San Francisco, has endowed twenty-eight undergraduate scholarships in the University, and seven graduate scholarships, of the value of $250, have been endowed by other doners. The number of students in the University has increased from 918 in 1891–2 to 2,250 in the present year. It is again stated that the University will receive gifts amounting to $5,000,000 for buildings, of which sum $1,200,000 is promised by Mrs. Hearst, of San Francisco.

Chicago University has received a gift of $225,000 from Mrs. Mary Esther Reynolds in fulfilment of a pledge made nearly five years ago.

Dr. Hugo Münsterberg, professor of experimental psychology in Harvard University, will return to Cambridge at the opening of the next academic year. He has hitherto retained his position in the University at Freiberg, and during the past two years has been in residence at that University.

Dr. Heinrich Ries has been appointed to the Barnard Fellowship of Columbia University. He will undertake the study of the physical properties of clays.

Professor William John Sollas, F. R. S., D. Sc. Camb., Hon. LL. D., of Dublin, professor of geology in the University of Dublin, has been elected to the chair of geology at Oxford, vacant by the death of Professor Green. According to the London *Times* Professor Sollas was a foundation scholar of St. John's, Cambridge, and obtained a first class in the natural science tripos. In 1882 he was elected a Fellow of St. John's, and in 1889 was made a F. R. S. In 1878 he was awarded the proceeds of the Wollaston Endowment for his researches in fossil sponges, and in 1893 the Bigsby Medal for geological and paleontological investigations. Antecedently to his appointment at Dublin in 1883 he was first lecturer and then professor of geology and zoology in University College, Bristol. He has investigated in person many regions of Europe, America, Australia and Polynesia. He was last year sent by the Royal Society in charge of the scientific expedition to Funafuti.

Professor H. W. Hughes. M.B., M.S. (Edin.) has been appointed professor of anatomy at King's College, London.

Professor Rucker, F.R.S., has been appointed Reade lecturer at University of Cambridge for the present year. Mr. F. F. Blackman, of St. John's College, has been appointed university lecturer in botany. Dr. Arthur Willey has been elected to the Balfour studentship in animal morphology for another year.

Dr. John Yule Mackay, professor of anatomy of the University of Dundee, has been appointed principal of the College.

The Clothworkers' Company, of London, has offered £200 for five years, and Miss E. A. Ormerod offers £100 toward the emolument of the Sibthorpian professorship of rural economy at Oxford.

It appears from the report for 1896 of the New York Examination Department of the University of the State of New York, on about 400,000 papers submitted by academic students, that the increase is greater in languages than in science. Not only do English and modern languages show an increase, but also Greek and Latin, whereas six of the eleven branches of science show a decrease. Thus there is an increase of 1,304 papers in first-year Latin and a decrease of 1,322 in geography, of 1,186 in physiology and hygiene, of 907 in physical geography, of 310 in physics, Part I., of 197 in chemistry, Part I., and of 145 in botany. The causes for the decrease of the number of students studying science in our schools at a time when there is an increase in the number of those studying literature and languages should be considered by the State Science Teachers' Association at the next annual meeting.

DISCUSSION AND CORRESPONDENCE.

DIFFRACTION OF X-RAYS OBTAINED BY A NEW FORM OF CATHODE DISCHARGE.

TO THE EDITOR OF SCIENCE: Will you allow me to publish a very brief statement concerning some work which is now in progress on the diffraction of X-rays. The trouble has been in obtaining a sufficiently intense source to give diffraction bands with the very narrow slits that must be used. After considerable experimenting I have found a new method of producing the rays, by which the intensity of radiation per unit of area of radiating surface is from ten to twenty times as powerful as in the best focus tubes. A 'total radiation' equal to the large focus tubes has not yet been obtained. The rays are produced by an arc-like discharge between two very small beads of platinum in a high vacuum. The discharge bulb is only about an inch in diameter, while the radiation (which comes from an area about the size of a pinhead) is strong enough to show the bones in the forearm. The 'arc' appears to be a new form of cathode discharge and can only be produced under peculiar conditions. I am now using a tube with a platinum slit 1 mm. wide, mounted within the bulb at a distance of 2 mm. from the radiating bead. The second slit of variable width is placed at a distance of 10 cm. from the first and the photographic plate at distances varying from 10 to 30 cm. from this.

The images of the slit on the plate show a distinct dark line on each edge, which I can only explain on the supposition that interference occurs. The plate is at too great a distance from the slit for such an effect to be produced by reflection of the rays from the edges. Images of fine wires show similar phenomena.

As yet I have not succeeded in getting a maximum of the second order, possibly because of under exposure of the plates. The details of the work will appear shortly in *Wiedemann's Annalen* and *The Physical Review*. I am under great obligation to Professor Cross for his kindness in placing at my disposal the facilities of the physical laboratory of the Massachusetts Institute of Technology.

R. W. WOOD.

JAMAICA PLAINS, MASS., March 31st.

THE HEIGHT AND THE VELOCITY OF THE FLIGHT OF A FLOCK OF GEESE MIGRATING NORTHWARD.

DURING the three days ending March 22d numerous flocks of geese were seen migrating northward, or rather northeastward, since they were following the general trend of the coast line, which, in New England, is nearly northeastward north of Cape Cod. On the morning of March 22d, while Mr. A. E. Sweetland and I were measuring clouds, at the ends of a base line 1178.4 meters in length, extending from the Blue Hill Meteorological Observatory to the base of Blue Hill, we succeeded in measuring, with our cloud theodolites, the height and the velocity of flight of one of these flocks of geese. So rapid is the velocity of flight that the flock was visible to the observers only about two minutes, but during that time two sets of measurements, were taken with the theodolites on the leader of the flock. The first measurements, at 8.49 a. m., were accurately taken at the Observatory station, but were only approximate at the other station. The second measurements, at 8.50 a. m., were accurate and simultaneous at both stations. Using the second set of observations at both stations for the height and the two sets of observations at the observatory station for the velocity, the calculations gave the height as 905 feet above the Neponset River valley, or 960 feet above sea level, and the velocity of flight as 44.3 miles an hour. The direction of flight was from southwest to northeast.

The self-recording instruments at Blue Hill Observatory, 615 feet above the river valley, showed that the wind at the time of the measurements was from the west-northwest with a velocity of eight miles an hour.

The height calculated from the first set of observations at the two stations was 928 feet above the river valley. This result, though not considered strictly accurate, serves as a good check on the adopted value which is given above.

On a previous occasion as described in SCIENCE of January 1st, p. 26, we found a flock of ducks flying from the northeast at a height of 958 feet with a velocity of 47.8 miles an hour. The close agreement between the two results is sug-

gestive, though it may have been accidental.

H. Helm Clayton.

Blue Hill Meteorological Observatory,
Readville, Mass., March 25, 1897.

ARCHÆOLOGICAL DISCOVERIES MADE IN THE GRAVELS AT TRENTON.

To the Editor of Science: In Dr. Brinton's reference in your issue of March 12th to Professor Putnam's report to the Peabody Institute, he scarcely does justice to the recent archæological discoveries made by Mr. Ernest Volk in the gravels at Trenton. Dr. Brinton says, referring to Professor Putnam's description of chipped stones "found in the glacial deposits of the Delaware Valley," that "it is fair to say that geologists are not agreed about the age of these deposits." It cannot be that Dr. Brinton has Professor Putnam's recent facts clearly in mind or he would not make this remark.

For Mr. Volk's investigations have been carried on on the Lalor farm, which is clearly within the range of the 'Trenton gravels' ascribed to glacial floods by every recent geologist who has visited them, including Professors Cook, Shaler, Chamberlin and Salisbury. This farm lies fifty feet above the level of the Delaware river, and abuts directly upon it. Boulders two or three feet in diameter are lying about loose upon the surface in the immediate vicinity. Mr. Volk, under Professor Putnam's direction, has systematically dug over acres of this farm and has found hundreds of chipped pieces of argillite in the undisturbed layers of sand which are everywhere found from two to three feet below the present surface. In the upper twelve inches of the soil, where there are evidences of disturbance, great numbers of jasper and flint implements have been found, together with some argillite implements; but in the lower two feet excavated no jasper and flint implements have been found, but only argillite; thus demonstrating the correctness of Dr. C. C. Abbott's previous observations, and excluding the various extravagant theories propounded to account for their burial by natural causes; such as overturning of trees, the burrowing of animals and the cracking of the soil.

I would say that I have had the privilege of accompanying Mr. Volk during some of these excavations, and can add my testimony to his as to the genuineness and importance of these very significant discoveries. In this case there is no chance to claim that they have been buried in the talus; for in the cases which I saw with my own eyes the implements were dug up from the undisturbed strata of the sand more than one hundred feet back from the edge of the bluff.

I trust that the Philadelphia geologists and archæologists will give more personal attention to the work which Professor Putnam, through Mr. Volk, is so successfully carrying on in that disputed district. G. Frederick Wright.

[When Mr. Volk's specimens were exhibited at Buffalo Professor McGee stated in the Section that he did not consider that the age of the deposit in which they were found is positively ascertained. The sand layers overlie the gravels, and have usually been supposed to be considerably later. Mr. Volk has not found the specimens referred to in the true, undisturbed gravels.—D. G. Brinton.]

AN IMAGINARY FLEET.

To the Editor of Science: Permit me to congratulate you for the extremely just and advanced view you take of what a university should be. In your issue of March 19, p. 471, I find, to my great satisfaction, "Research is not only the primary object of the university; it is the university itself." So dominant is this sentiment in my mind that I have attempted the establishment of a department where all work, however elementary, shall be carried on after the manner of original research.

Would that the statement found on p. 473 of the above-mentioned date were true, viz., that the trustees of Cornell University are going to build me a naptha launch for the transportation of my students in paleontology; would also that the launch were forthcoming that a prominent firm writes me about, viz., one they understand the 'Cornell students' are making for me. These, with the one I *am personally* having built by Lintz & Co., Grand Rapids, Michigan, would certainly form an enviable fleet for the prosecution of paleontologic research.

G. D. Harris.

Cornell University.

THE METRIC SYSTEM.

TO THE EDITOR OF SCIENCE: Is it not a little incongruous for American scientists and scientific journals to urge upon Congress the legalization of the metric system to the exclusion of the old, while SCIENCE prints, without comment and in a quasi-editorial way, an abstract of government researches in which all weights are in ounces?* Would you not be warranted in declining any contribution in which were not given at least the metric equivalents?

BURT G. WILDER.

CORNELL UNIVERSITY.

[Men of science and scientific journals ought certainly to use the metric system when possible. The United States Department of Agriculture cannot, however, afford to lessen its usefulness and to awaken criticism by making such of its researches as are intended for the general public more technical or difficult to understand than is necessary. It is consequently not certain that the metric units should have been used in this work on metabolism so long as foods are sold by pounds and ounces. It is often useful to give the common equivalents of the metric system in order that the matter may be understood and to teach the equivalents, but it is not often desirable to give the metric equivalents of the common system. Nothing is gained in clearness for Anglo-Saxons, and, as far as missionary work goes, the long series of decimals naturally required to express ounces or feet in the metric system give it a cumbrous and forbidding aspect. ED.]

SCIENTIFIC LITERATURE.

The Formation of the Quaternary Deposits of Missouri. By JAMES E. TODD. Reports of the Missouri Geological Survey, Vol. X. [1896], pp. 113–217, with two maps, four section plates, five full-page illustrations, and five small figures in the text.

No detailed study of the Quaternary deposits of Missouri has ever been attempted, except in a few limited districts, but short references to them are scattered through all the reports of the several Geological Surveys which have, in the past, been instituted in the State. By a careful compilation of these fragmentary notes, supplemented by much personal observation, Professor Todd has collected a large body of valuable information on the later geological history of the northern portion of the state. His intimate knowledge of the general features of the Pleistocene formations as developed in other states, has enabled him to produce a very concise description, and his conclusions, in the main, seem to be fully warranted by the data given.

The Quaternary formations are classified into (1) the Bouldery Drift, (2) the Loess and Gray Loamy Clay, (3) Terrace Deposits, and (4) Alluvium.

In many respects the drift deposits of Missouri are remarkable. The till, or boulder clay, is found in the north-central portion of the State in considerable thickness, but thins thence in a southwardly direction, as also toward the Mississippi and Missouri rivers. Over a large portion of the state north of the Missouri river it is less than five feet in average thickness, "and over considerable areas consists of small, shallow, detached patches. Toward the margin of the drift it usually disappears, and gives place to sparsely scattered boulders of northern origin." There is a total absence of distinct moraines, drumlins, kames, eskers, 'kettle holes,' basins, knobs, and the other classes of irregularities of surface usually found in drift-covered regions. No buried forest beds have been reported, and but few striæ observed. Probably the most interesting part of Professor Todd's discussion of the drift proper is a description of the small driftless areas in Ralls, Pike, Lincoln and Saint Charles counties. They correspond to a similar driftless ridge studied by Leverett in Pike and Calhoun counties, in western Illinois.

The second great formation of the Quaternary deposits of Missouri is the Loess and Gray Loamy Clay. The two are considered merely as different phases of the same formation. This is shown to extend, in probable original continuity, over nearly the whole of the northern portion of the state, but to terminate southwardly at an irregular line, whose position seems to be controlled by the topography. It descends from about 950 feet above the sea, at

*Experiments upon metabolism, etc., March 26, 1897, pp. 493–496.

Kansas City, to 825 feet, at Pilot Grove, in Cooper county. Except in Lafayette, Pettis and adjoining counties, it is never far beyond the recognized limits of the drift sheet. Along the Missouri river, especially at and near Kansas City, two divisions of the *loess* are recognized. The 'higher loess' is that which has the widest extension, being found nearly everywhere in association with the drift sheet, while the 'lower loess' forms high terraces along the Missouri valley. It is the latter which has furnished most of the data concerning the *loess* which have heretofore been reported from Missouri.

Much valuable information is given of the trough of the Missouri river, and the question of its age relative to the epoch of glaciation of its vicinity is discussed in considerable detail; also, the preglacial and present valleys of the Mississippi river between Montrose and Keokuk, Iowa. The sections of the old and new gorges are especially finely executed.

In the discussion of the origin of the Missouri Pleistocene formations, the following leading problems are recognized: 1. Waterlaid character of the *loess* and gray loamy clay. 2. Great difference of level between similar deposits in Missouri and southern Illinois. 3. Vastness of gorges of the Missouri and Mississippi rivers. 4. Absence of drift in the lower Missouri. The Missouri *loess* deposits are referred to a fluvio-lacustrine origin. A barrier in the form of a rocky ridge is supposed to have formerly extended from the present divide between the Osage and Glasconade rivers, across the present course of the Missouri river, through Warren, Saint Charles, Pike and Ralls counties, to and connecting with a ridge in Pike county, Illinois. This barrier, by preventing free drainage toward the lowlands in southern Illinois, is supposed to have enabled the waters flowing away from the melting ice sheet to deposit the *loess* and loamy clay on the drift plain to the northwest of it, while a similar formation was being laid down at a much lower level in the country southeast of it.

In summing up the Quaternary history of Missouri, Chamberlin's classification of the Pleistocene formations is adopted. The major portion of the drift proper is referred to the Kansan epoch. The Aftonian interglacial epoch is scarcely represented in Missouri, but its effects may be recognized in slight valley erosion, particularly in the extreme northwestern part of the State. During the Iowan epoch the ice sheet is believed to have again advanced into territory now included in Missouri, but to a less distance than formerly. The *loess* is also referred to this epoch. The succeeding Toronto and Wisconsin epochs are inseparable in this state, but their effects consisted largely of increased depth of stream erosion.

The present writer desires to suggest that the idea that the distinctive deposit commonly known as *loess* was deposited by broad semi-lacustrine stream floods, originated from the study of flat areas where the formation was laid down as a nearly uniform sheet upon a plain. This hypothesis would not have originated upon certain other areas, for instance, the upper Mississippi region, where a *loess* of the same age as that of Missouri and nearly identical in the lithological features, mantles almost equally as uniformly, a characteristically hilly land surface. Here, undoubtedly, a purely lacustrine or possible semi-marine origin must be assumed for the waterlaid silt and loamy clay which covers hill-tops, slopes and broad flat valley-bottoms alike. It may be possible that the great difference in altitude between the *loess*-covered plain of southern Illinois and the much more elevated drift and *loess* plain of northern Missouri may be the result solely of the original altitudinal diversity of the preglacial land surface upon which they are superimposed. The supposed barrier from the Osage-Gasconade divide to the driftless ridge in Pike county, Illinois, would thus become unnecessary.

O. H. Hershey.

Angewandte Elektrochemie. Erster Band. Von Dr. Franz Peters. Hartleben's Verlag, Wien; Leipzig.

Electro-chemistry is one of the most recent subdivisions of chemical science. The study of its theoretical side has been most actively promoted and splendid results have been brought to light. Applied electro-chemistry is of even

more recent date; still, it has become the subject of very general attention. Separate or special chairs devoted to this branch have been created at several of the foreign technical schools, and journals intended for the publication of its distinctive methods and practices have been established. Efforts are now being made to gather in the widely spread literature relating to this subject. The volume before us presents a very full, although not exhaustive, treatment of all the sources of electric energy, the dynamo excepted. The author aims, in this volume, to give a concise account of the various forms of primary batteries and storage cells which have been devised at various times, and adds information in regard to the same which will prove helpful both to those who are engaged in promoting electro-chemical processes and to students who are seeking to gain for themselves as complete a knowledge of this subject as is possible. Some idea of the contents of the volume may be obtained from the following topics: A. Galvanic Batteries: 1. Batteries with one electrolyte. 2. Batteries with two electrolytes. 3. Dry batteries. 4. Normal batteries. 5. Suggestions for the construction of batteries and their components. B. Batteries serving for production of electric energy directly from carbon. C. Gas batteries. D. Thermopiles. E. Accumulators.

The author has treated his subject understandingly and has prepared a work which will prove of great value to all interested in applied electricity. It is his purpose, at an early date, to issue companion volumes, dealing with the application of electricity to metallurgy, to galvanoplastic processes, to chemical analysis and to industrial chemistry. The subject-matter in these later volumes is to be discussed in a thoroughly practical manner.

EDGAR F. SMITH.
UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE April number opens with an extended article by A. M. Mayer, giving the results of a long series of investigations of the phenomena of flotation of disks and rings of metal. The author briefly reviews the early literature on the subject and notes the erroneous statement often repeated in treatises on physics that a film of grease is necessary to float a piece of metal on a water surface. With respect to this point his results confirm the idea that the film of air which adheres to the body is essential to its floating, since rings of metals, as also rods of glass, sank in water if they had been heated and the air expelled, but regained their power of flotation after being exposed to the air for some 10 or 15 minutes. The disks experimented upon were made of aluminum, but the rings were made also of other metals, as iron, copper, brass, etc. The method of experimenting made possible the accurate determination of the depression of the water surface and also of the weight required to just break it and allow the disks or rings to sink. In the case of the rings the form of the water surface was more complex and called for special investigation. The equation of forces acting upon the disk of aluminum allowed finally of a determination of the surface tension of water, which was found to be .0791 as the mean of three determinations. With rings of different metals the value obtained was .0809. The mean of twenty-eight determinations of this constant by various physicists during the past sixty years is .0772. The surface tension of a solution of sodium chloride of a density of 1.2 was also determined and found to be .0860 (using the value .0772 for water).

George F. Becker contributes a paper on the method of computing diffusion with special reference to the diffusion in the viscous fluids as applied to geological phenomena. This is in connection with an earlier discussion by the same author on rock differentiation, published in the January number. E. O. Hovey discusses the rock of a dike in the Connecticut Triassic area, a few miles east of New Haven. This rock is remarkable in that it departs from the usual diabase character which so remarkably characterizes the Triassic igneous rocks of the entire Atlantic border. It is distinctly acid in character and seems to belong to the group of keratophyres. F. A. Gooch and C. F. Walker discuss the application of iodic acid to the analysis of iodides. The granitic rocks of the Pyramid Peak district in the Sierra Nevadas

of California are described by W. Lindgren. These include granites proper and the granodiorite, which is characterized as an intermediate type, neither a normal diorite nor a granite, but occupying a place between normal quartz-mica-diorite and quartz-monzonite; also normal diorite and gabbro from smaller areas inclosed in granodiorite or granite, or on the contact between them and the schists. It is concluded that all of the granite rocks are later than the altered sedimentary rocks described and the augite-porphyrite, though the relative age of the granite, granodiorite, diorite and gabbro, is not decisively settled. "The probability is that the intrusion both of the granite and of the granodiorite was accompanied by minor intrusions of acid and basic magmas, and that there are diorites, pegmatites and aplites, of the age of the granodiorite and of that of the granite, the latter being the older rock."

R. S. Tarr discusses the difference in the climate of the Greenland and American sides of Davis's and Baffin's Bay. The former name is proposed for the bay between Labrador and Greenland, south of Davis' Straits. When in the Arctic region in the summer of 1896 the author noted the remarkable difference in climate of the two localities, the eastern side being distinctly warmer and at a given time more free from snow and ice than the western. The cause of this is found largely in the ocean current moving northward on the Greenland coast, to which is added the influence of the winds. Remarks are also made on the changes of level of Baffin Land and its relation to glaciation. E. C. Case describes the foramina perforating the cranial region of a Permian reptile. The paper is accompanied by a series of cuts.

John Trowbridge and Theodore W. Richards discuss the temperature and ohmic resistance of gases during the oscillatory electric discharge. The paper gives the result of a series of experiments which have led the authors to conclude that "a mass of gas at low tension contained in a capillary tube may act as though it opposed a resistance of only five or six ohms to the spark of a large condenser." Plücker tubes were employed with aluminum electrodes and the voltmeter allowed of measuring the voltage up to 1,800 volts and above by approximation. A battery of from five to ten thousand storage cells was employed with a large condenser and a water resistance interposed of from five to fifty megohms. A series of tables give the number of half oscillations corresponding to varying resistances and capacities. Experiments were made with hydrogen and nitrogen gas in particular, and the evidence reached from them is summed up as follows:

"(1) The resistance of a gas at low pressure to the oscillatory discharge is equivalent to only a very small ohmic resistance. (2) This resistance is in general greater the less the quantity of electricity. (3) Down to a very small pressure this resistance decreases with the tension of the gas. (4) The form of the tube has an important effect upon the resistance of the gas. (5) With the oscillatory discharge it is evident that the electrodes produce far less effect than with the continuous discharge." Certain conclusions are also suggested as to the effect of the dissociation in diminishing the resistance of the gas experimented upon, thus tending to explain the difference of the spectra obtained under different conditions. In a following article, discussing whether a vacuum conducts electricity, Trowbridge states that his experiments lead him to believe that "a disruptive discharge of electricity encounters its chief resistance at the going-over layer between the electrodes and the medium, and that during the discharge in a highly rarified medium very little resistance is encountered."

I. C. Russell discusses the plasticity of glacial ice, with reference to recent experiments by McConnell, Kidd and Mügge. The observations made of the optical structure of the ice lead to the conclusion that "the yielding of glacial ice to pressure is due to movements along gliding planes in the granules of which it is composed." The closing article is by O. C. Marsh on the affinities of the Cretaceous bird, *Hesperornis*. He recalls his early conclusions that the hesperornis was allied to the ostriches and shows that they are confirmed by the recent discovery of a specimen showing feathers in place and these feathers are the typical plumage of an ostrich. In the notes which follow A. E. Verrill states that in the examination of a mass of the integument from the supposed

octopus cast ashore on the Florida coast, some months since, it has been shown that the mass resembles not an octopus, but rather the substance which forms the head of a sperm whale. The nature of the original animal is still in doubt, since no known species could have yielded a mass of this size, entirely free from any bony structure.

THE ASTROPHYSICAL JOURNAL, FEBRUARY.

The Absorptian of Light as a Determining Factor in the Selection of the Size of the Objective for the Great Refractor of the Potsdam Observatory: By H. C. VOGEL. The author discusses the effect of absorption upon the 'light-grasping power' of objectives of various apertures. The first part of the paper deals with the experiments for the determination of the absorption of the various varieties of glass available for large objectives. The second part consists of the application of the constants thus obtained to the determination of dimensions. Assuming the ratio of diameter of lens to thickness to be between six and seven, it is shown that an increase in aperture above 80 cm. gives very little corresponding increase of light. This is due to the additional absorption which is entailed by the increased thickness. An increase in diameter from 35 cm. to 80 cm. multiplies the light-gathering power by four, while a further increase to 100 cm. adds another factor of only 1.4. In view of the rapid increase in cost of a telescope, corresponding to an increase in size, and the smallness of this last factor, Dr. Vogel considers 80 cm. as about the most economical diameter. As the telescope is to be used chiefly for astrophysical work, it is to be corrected for photographic rays, and it is the absorption of these which determined the dimensions. The life partner of the great refractor is to be a visually corrected finder of 50 cm. aperture.

The Spectrum of Puppis: By E. C. PICKERING. As was announced in *H. C. O. Circular*, No. 12 (Ap. J., Dec., 1896), the spectrum of Puppis contains two rythmical systems of dark lines, one being the known series due to hydrogen. It was also announced that the other series is governed by a law somewhat resembling Balmer's law for hydrogen. In the present paper the writer points out that by a modification, Balmer's formula may be made to satisfy both series. The formula as ordinarily written (for Rowland's scale) is $\lambda = 3646.1 \frac{m^2}{m^2-4}$, where $m = 3, 4, 5, 6$, etc., substituting $\frac{1}{2} n = m$ we obtain $\lambda = 3646.1 \frac{n^2}{n^2-16}$, which gives the hydrogen lines when $n = 6, 8, 10, 12$, etc., and the lines of the newly discovered series when $n = 5, 7, 9, 11$, etc. In the light of this remarkable relation it seems probable that the new series is, in fact, due to hydrogen under some physical condition so far unknown upon our globe.

On the Spectrum of Puppis: By H. KAYSER. In connection with this spectrum Professor Kayser calls attention to the fact that hydrogen is the only element which has, until now, been considered to have only one series of lines. In every other case where series have been found to exist, there are two converging approximately to the same limit, each satisfying a formula of the type $\frac{1}{\lambda} = A - Bm^{-2} - Cm^{-4}$ where $m = 3, 4, 5, 6$, etc. The alkali metals have in addition a third series, brighter than these two. It has been generally supposed heretofore that the ordinary hydrogen spectrum consisted of this series. Certain considerations however seemed to contradict this. The newly found series in Puppis now fits in very neatly, converging approximately to the same point as does the old one. In the light of these developments more accurate measurements of the positions of the new lines will be of great interest.

On the Effect of Pressure in the Surrounding Gas on the Temperature of the Crater of an Electric Arc. Correction of Results in Former Paper: By W. E. WILSON and G. F. FITZGERALD. "The primary object of this research was to determine, if possible, whether the temperature of the crater in the positive carbon varies when the pressure in the surrounding gas is changed." The result is interesting as bearing directly upon the mooted question as to whether the temperature of the crater is that of boiling carbon. If such were the case we should expect a rise in the temperature of the crater with in-

creased pressure, corresponding to a rise in the boiling point of carbon. The radiation from the crater was measured with a radiomicrometer. Since the radiation varies as the fourth power of the temperature, a slight change in the latter should be noticeable. The experiments were not definitive, on account of the many difficulties encountered, but seemed to show that the temperature remained constant throughout a range of pressure of from one to seven atmospheres. At any rate, the constancy was sufficient to practically disprove the boiling-point idea. Among the chief difficulties to be met were connection currents in the apparatus, which rendered the gases so opaque as to suggest to the writers a new explanation of sun spots. The paper has the additional interest of indicating that temperature effects can not play an important part in the shifting of lines in metallic spectra when pressure is applied to the arc.

Preliminary Table of Solar Spectrum Wavelengths, XVII.: By HENRY A. ROWLAND.

On the Comparative Value of Refracting and Reflecting Telescopes for Astrophysical Investigations: By GEORGE E. HALE. The paper, as is indicated by the title, is a discussion of the relative merits of the two forms of instruments mentioned. In addition to economy, freedom from chromatic abberation, and other advantages sometimes urged in favor of reflectors, Professor Hale brings forward that of their relative freedom from absorption. The effect of this in large refractors is discussed in the above paper by Dr. Vogel, and is shown to increase with the size. Since the percentage of absorption of a reflector is independent of its dimensions, this factor is of great importance where large apertures are concerned. The paper is accompanied by an interesting diagram, which shows, among other things, that for linear apertures greater than 90 cm. the *photographic* [light-gathering power of a reflector exceeds that of a refractor.

On a New Form of Mounting for Reflecting Telescopes Devised by the Late Arthur Cowper Ranyard: By F. L. O. WADSWORTH. The writer discusses some developments of the idea of the Cassegraiman Condé proposed by Mr. Ranyard. Several forms of mounting are considered. In every case, with one exception, the polar axis is of the fork type. A mirror at the intersection of the polar and declination axis is so arranged that its plane always bisects the angle between the telescope and polar axis, so that light from the small convex mirror is always thrown up or down the polar axis (which is hollow), as may be desired.

A Support System for Large Specula: By G. W. RITCHEY. In this article Mr. Ritchey describes a support system designed to reduce to a minimum the effects of flexure in large mirrors. The system is in reality a double one: 1. The back support. 2. The edge support. In the first system the mirror is considered as divided, by cylindrical surfaces perpendicular to the back of the mirror, into twelve parts of equal mass. Each part rests upon a support. Nine of these supports are counterbalanced in all positions by weighted levers, while the remaining three rest upon the cell. It is evident that if all twelve supports were counterbalanced the mirror would be in equilibrium in any position close to its normal one. If three of the supports are fixed, however, the nine remaining counterweights will be unable to take any of the weight off of the fixed supports which will, therefore, determine the plane of the mirror. The mirror will, therefore, *float* in a fixed plane. The edge support is designed upon the same general principles. There is reason to believe that the plan will combine with a perfect flotation support, a degree of stability heretofore unattained in speculum mounting.

Oxygen in the Sun: By LEWIS E. JEWELL. See foot-note to abstract of App. J, December, 1896, in SCIENCE, March 19th.

Minor Contributions and Notes, Reviews, Bibliography.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, MEETING FEBRUARY 10.

ABSTRACTS OF PAPERS PRESENTED.

*On the Morphology of the Skull of the Pelycosauria and the Origin of the Mammals.** By G. BAUR and E. C. CASE.

*A fuller account of this paper has just been published in Anatom. Anzeiger, XIII. Band., No. 2 and 5, January 30, 1897, pp. 109–120, with three figures of the skull.

The sub-order Pelycosauria was established by Professor Cope in May, 1878, for certain Reptilia, especially *Clepsydrops* and *Dimetrodon*, from the Permian of Texas. It was said to differ from the Rhynchocephalia by the absence of the quadrato-jugal arch. At the end of the same year the order *Theromorpha*s was established, as distinct from the *Rhynchocephalia*, containing the suborders *Pelycosauria* and *Anomodontia* (Owen).

The characters of this order with its two suborders were given as follows:

Theromorpha, Cope. Scapular arch consisting at least of scapula, coracoid and epicoracoid which are closely united. Pelvic arch consisting of the usual three elements, which are united throughout, closing the obturator foramen and acetabulum. Limbs with the phalanges as in the ambulatory types. Quadrate bone proximally united by suture with the adjacent elements. No quadrato-jugal arch.

Pelycosauria. Two or three sacral vertebræ; centra notochordal; intercentra usually present. Dentition full.

Anomodontia. Four or five sacral vertebræ; centra not notochordal; no intercentra. Dentition very imperfect or wanting.

The order *Theromorpha* was regarded by Professor Cope as approximating the Mammalia more closely than any other division of the Reptilia, and as probably the ancestral group from which the latter were derived.

The order *Theromora* has been admitted by nearly all paleontologists and zoologists, and the opinion of the close relationship of this group with the Mammalia has found very many supporters.

This view is not correct. It is shown that the order *Theromora* has no existence. The *Pelycosauria* cannot be brought together with the *Anomodontia*, since they have both the upper (postorbito-squamosal) and lower (quadrato-jugal) arches, like the Rhynchocephalia.

This result was reached by the study of an excellent specimen of *Dimetrodon incisivus*, Cope, collected in the spring of 1896, by Dr. E. C. Case, while in charge of the field expedition of the department of paleontology of the University of Chicago.

The following conclusions were reached, after the description of the skull and the principal portions of the skeleton:

The Affinities of the Pelycosauria.

There cannot be any doubt that *Dimetrodon* is nearest to the *Rhynchocephalia* and *Proganosauria* (*Palæohatteriidæ*). The structure of the skull, the vertebral column, and the humerus are of the same type.

The specialization of the *Pelycosauria* consists in the enormous development of the neural spines of the dorsal vertebræ, and in the reduction of the upper part of the quadrate and its nearly complete inclosure by the squamosal, prosquamosal and quadrato-jugal. *It is quite evident that the Pelycosauria with the two temporal arches, and the specialized neural spines cannot be the ancestors of mammals;* they represent a specialized side branch of a line leading from the Proganosauria to the Rhynchocephalia, which becomes extinct in the Permian.

The mammals have a single temporal (zygomatic) arch; the posterior nares are placed far back, and are roofed over the maxillary and palatine plates; the quadrate is completely coossified with the squamosal and quadrato-jugal; the occipital condyle is double, the entepicondylar foramen is present in all the generalized forms. The ancestors of mammals must show the same condition.

Seeley has combined a number of Permio-Triassic Reptilia from South Africa into an order which he calls *Gomphodontia*. These reptiles are: *Tritylodon*, Owen (always so far considered a mammal); *Diademodon*, Seeley; *Gomphognathus*, Seeley; *Micro gomphodon*, Seeley; and *Trirachodon*, Seeley.

In *Gomphognathus* we have a double occipital condyle; the posterior nares are placed far back and are roofed over by the maxillary and pterygoid plates, and there is an entepicondylar foramen. The quadrate seems to be of the reduced form; a condition we see also in the closely related *Cynognathus*.

These forms look very much like mammals and could possibly be ancestral to them. We must suppose that the condition of the palate seen in the Mammalia and *Gomphodontia* has been developed from a type which we find among the *Rhynchocephalia*. The *Crocodilia*, where we have a palate similar to that of mam-

mals, show us how such a type of palate was developed from the Rhynchocephalia, through the Belodonts and the Teleosaurs. It is possible that the *Gomphodontia* originated from the *Proganosauria*.

We are fully convinced that among these South African forms, one of which was for a long time considered a mammal, we have those reptiles which might be considered as ancestral to the mammals or at least closely related to their ancestors. Further finds and careful critical observations have to decide this.

The Cranial Region of Dimetrodon. By E. C. Case.

The paper presented additional evidence of the relationship of *Dimetrodon incisivus*, Cope, to the living and extinct Rhynohocephalia.

It was shown that in *Dimetrodon* there was a common distal opening of the eustachian tubes, as in the *Crocodilia* and aglossal *Anura*, and that this opening corresponded to a deep pit in the posterior part of the lower surface of the basisphenoid. There was a large hypophysis, which extended backward nearly as far as the tympanic region, and occupied an excavation of the lower part of the basioccipital, just as the hypophysis occupies an excavation in the basisphenoid in young *Crocodilia*. The tympanic region was not separated from the brain cavity by a wall of bone, but communicated freely as in fishes and some amphibians. A cast of a part of the brain cavity showed that the posterior region was very similar to the brain of *Sphænodon*. The nerves all occupied similar positions. The cerebellum was probably thin antero-posteriorly, elongated from side to side and elevated. There was a sharp descent of the medulla in its anterior portion, forming an angle with the part anterior to it. This angle is very apparent in the brain of *Sphænodon*, but absent in most other Reptilian brains, where the medulla is horizontal or joins the mid-brain at only a very slight angle.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 261st regular meeting of the Society was held Tuesday evening, March 16, 1897.

Professor Thomas Wilson read a paper on 'A Cañon in Prehistoric Archæology,' in which he said that the more widely extended is the search for prehistoric man the greater will be found the area that he occupied, and the more profound the excavations the greater will be found the antiquity of that occupation. This is not meant to indicate that prehistoric man occupied all the area of the world, nor that, having once discovered his occupation of a certain area, an extension of the investigation would necessarily show an extension of the area. The theory maintained is that, having shown his occupation of a certain locality, investigations made in other localities, or in other portions of the same country, will show his increasing and wider distribution and occupation. It is a proposition announced by the foremost prehistoric archæologists that prehistoric man is not found in proportion to the number of sites occupied by him, nor by the density of his population, nor yet by the number of objects which he has left, but is, on the contrary, in proportion to the number of seekers. The world has hardly yet awakened to a just appreciation of the extent of the occupation of the earth by man during prehistoric times, nor yet to his antiquity. He used, as illustrations, the reports recently made by archæologists of investigations in two countries. The first, Babylon, has resulted in pushing the historic period back to a much greater antiquity. The other country, the prehistoric occupation of which has been doubted, if not denied, is Egypt, and is the result of investigations and excavations lately made by the Director-General of Antiquities in charge of the Gizeh Museum. He then detailed the investigations and results in these countries, exhibiting a rare collection, which he had obtained from Mr. de Morgan, the head of the Gizeh Museum, to whom the greatest credit is due for these researches.

Mr. R. T. Hill then read a paper on 'Some Phases of the Negro of the West Indies,' in which he described the geographic distribution, the difference in type, the social and political conditions of the negro in the several islands and groups of islands. Obeaism, or voodooism, is widespread in its practice and powerful in its influence, nearly all of the common people believing in Obeah, not only the blacks and

colored, which is the term applied to mulattoes, but the whites. A member of the City Council of Kingston was suspected of being a prominent Obeah man. The Obeah man is always flogged when detected in such practice. The object of this practice, or worship, as it is often called, is to: (1) Thwart or remove the spirits of the departed. (2) To bring success. (3) To punish enemies. (4) To prevent theft. They consist of sacrifices, charms, terrorizing and hypnotizing influences. To remove duffies or ghosts, a cock is sacrificed, and they hang up a bottle of water. To bring success they strew rice and other powders. To punish enemies they sacrifice a cock, cut off feet and head and plant the head with beak toward the door of the enemy. To prevent theft they hang up a bottle. The belief in duffies or ghosts is the most striking feature of Obeaism; charms are worked to keep the duffies in their graves and to keep them out of their homes. Sacrifices and practices of the most inhuman and revolting character are sometimes performed, and instances of human sacrifices were known. Every unexplainable act is credited to the duffies, and a negro will not answer a knock at his door after dark for fear it will prove a duffie. Many curious and interesting beliefs and customs were related. Discussed by Professor Mason, J. H. Blodgett, Drs. Frank Baker, J. H. McCormick and others.

J. H. MCCORMICK,
General Secretary.

NEW YORK ACADEMY OF SCIENCES; BIOLOGICAL SECTION, MARCH 8, 1897.

THE papers presented were:

H. E. Crampton, 'On the Ascidian Half Embryo.' His experimental studies on the egg of *Molgula manhattensis* showed that the isolated blastomeres segment in a strictly 'partial' manner, but that a gradual passage to a 'total' development ensues. As far as the early stages were concerned, Chabry, Roux and Barfurth are entirely correct in arguing for a half or 'partial' development. But Driesch, Hertwig and others are also correct in considering the end result a 'total' larva of less than the normal size. The paper will be published in full.

N. R. Harrington, 'On a Nereid from Puget Sound (Pacific coast), which lives commensally with the Hermit crab, *Eupagurus alaskensis*.' A variety of the western European species, *N. fucata*, is known to inhabit deserted whelk cells with *Eupagurus bernhardus*, and a careful comparison of the Old and the New World forms brings out resemblances in structure due to the operation of the same physiological factors. These are notably: (1) the degeneration of the muscular and cuticular layers in the posterior two-thirds of the body; (2) loss of the pigment in the same; (3) physiological factors may explain why only females are found (as yet) in this comfortable and nutritive habitat. The author surmises that the commensal form is the female epitocous type of some free living nereid.

This apparently undescribed species from the Pacific differs from *N. fucata B. inquilvina* of Wirèn in the arrangement of the paragnathi, respiratory lobes of notopodium and transverse pigment stripes.

Bashford Dean, 'A Posthumous Memoir of Professor J. S. Newberry.' This paper described new species and a new genus of North American fossil fishes, and discussed the genera *Oracanthus*, *Dactylodus*, *Polyrhizodus*, *Sandalodus* and *Petalodus*.

Among the types were species of *Cladodus*, *Oracanthus*, *Ctenacanthus*, *Stethacanthus*, *Asteroptychius*, *Dactylodus*, *Deltodus*, *Sandalodus*, *Psephodus*, *Helodus* and *Ctenodus*. *Dinichthys corrugatus* was taken as a type of a new genus, *Stenognathus*.

At the conclusion of the papers an election of sectional officers was held. Professor E. B. Wilson was elected Chairman for the ensuing year and Professor C. L. Bristol Secretary.

BASHFORD DEAN,
Secretary pro tem.

TORREY BOTANICAL CLUB, FEBRUARY 24, 1897.

THE first paper was by Mr. Arthur Hollick, 'A fossil *Arundo* from Staten Island.' The paper was presented by Dr. Britton, with prefatory remarks referring to this discovery. Its occurrence was in yellow sand of Staten Island, belonging to late Tertiary or early Quaternary; the locality, a pit near Port Wadsworth. The preliminary reference to *Phragmites* is now changed by Mr. Hollick to the tropical genus Arundo.

Mr. E. O. Wooton made 'Remarks on some of the rarer Plants of New Mexico,' sketching briefly the botanical regions of New Mexico, and tracing upon a map the routes traversed by most of the botanical collectors who have visited them. Mr. Wooton was himself practically the first to make collections in the southeast section of the Territory, a very interesting, botanical region, with high mountains, some of which were illustrated by photographs. Specimens of Mr. Wooton's collecting were then shown, exhibiting about thirty-five flowering plants and ferns, and including, among those familiar in the East, *Pellæa atropurpurea*, *Cystopteris fragitis*, *Pteris aquilina* and *Cheilanthes tomentosa*.

Mr. Rydberg compared some of the features presented by the sand region of central Nebraska; referred to *Muhlenbergia pungens* and other so-called '*blow-out* grasses' of the sand-hills, and described the formation of the characteristic 'blow-outs' or hollows, originating in spots where the grasses had died out and deepening rapidly, sometimes to 300 feet, producing a country where the hills are moving every year, and where he, when camping, could find no fuel except roots of sand-cherries exposed along fresh 'blow-outs.'

Dr. H. M. Richards spoke 'On Some of the Reactions of Plants Toward Injury,' as shown by his experiments in Germany last summer. Diagrams illustrating the effect of injury upon both respiration and temperature were shown. In the former case it was seen that the respiration is greatly increased by wounding, attaining its maximum about 24 hours after the injury was inflicted; this increase depending both on the stimulus of the wound itself and upon the access of atmospheric oxygen to the tissues. The occurrence of a corresponding rise in temperature, of a local nature, was also briefly referred to; the temperature curve corresponding closely to that described by the increased respiratory activity. The thermo-electric apparatus used was described; its delicacy is such as to indicate a difference of $\frac{1}{100}$ of a degree; the result with potatoes showing a maximum rise of temperature of a little over $\frac{1}{10}$ of a degree at the end of the second day, falling to the end of the fifth day. A remarkable temperature rise in the onion of nearly $3\frac{1}{2}$ degrees was explained by the fact that here the rise was not local, but affected the whole onion, in accordance with the morphological structure, and with the fact that metabolism is carried on very fast in the onion.

The next paper was a contribution from Dr. Alexander Zahlbrückner, of Vienna, a corresponding member of the Club, entitled, 'Revisio Lobeliacearum Boliviensium hucusque cognitarum.' The paper, which is in Latin, enumerates all the species, giving synonymy and references to the literature, and cites collectors and their numbers. There are 39 species, as follows: 9 in *Centropogon*, 2 new; 20 in *Siphocampylos*, 7 new; 1 in *Laurentia*; 2 in *Rhizocephalum*; 3 in *Hypsela*; 4 in *Lobelia*.

Edward S. Burgess,
Secretary.

NEW BOOKS.

Agriculture in some of its Relations to Chemistry. F. H. Storer. New York, Charles Scribner's Sons. 1897. Seventh edition, revised and enlarged. Three Volumes. Pp. iv+610, iv+602, vi+679. $5.

Stones for Building and Decoration. George P. Merrill. New York, John Wiley & Sons. 1897. Second edition, revised and enlarged. Pp. ix+506. $5.

The Elements of Physics. Vol. III. *Light and Sound.* Edward L. Nichols and William S. Franklin. New York and London, The Macmillan Co. 1897. Pp. vii+201. $1.50.

The Outlines of Physics. Edward L. Nichols. New York and London, The Macmillan Co. 1897. Pp. xi+452. $1.40.

Hypnotism. Albert Moll. London, Walter Scott, Ltd. 1897. Fourth edition, revised and enlarged. Pp. x+448. 1s 6d.

Art Education. W. T. Harris. Syracuse, N. Y., C. W. Bardeen. 1897. Second edition. Pp. 77. 50 cents.

Les gaz de l'atmosphère. H. Henriet. Paris, Gauthier-villars et Fils, Masson et cie. Pp. 192.

Anleitung zur Mikrochemischen Analyse der Wichtigsten organischen Verbindungen. H. Behrens. Hamburg and Leipzig, Leopold Voss. 1897. Viertes Heft. Pp. vii+129. M 4.50.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, APRIL 16, 1897.

CONTENTS:

Sylvester: GEORGE BRUCE HALSTED.....597
The Great Fault and accompanying Sandstone Dikes of Ute Pass, Colorado: W. O. CROSBY.....604
Exhibition in Science by the New York Academy of Sciences: RICHARD E. DODGE.....607
The Missouri Botanical Garden.....610
The Ganodonta or Primitive Edentates with Enamelled Teeth: H. F. O.....611
Current Notes on Meteorology:—
The Exploration of the Air; Visibility of Mountains and Atmospheric Dust; The Blue Hill Meteorological Observatory: R. DEC. WARD.....612
Current Notes on Anthropology:—
The so-called 'Bow-pullers' of Antiquity; Fairyland; Recent Etruscology: D. G. BRINTON.....614
Notes on Inorganic Chemistry: J. L. H.....615
Scientific Notes and News.....616
University and Educational News.....619
Discussion and Correspondence:—
The Bruce Astronomical Medal: EDWARD S. HOLDEN. *Professor Scott's Bird Pictures*; F. A. LUCAS. *Note on a Simple Method for Newton's Total Reflection Experiment*: F. W. MCNAIR.....620
Scientific Literature:—
The Annual Report of the Geological Survey of Canada: C. H. HITCHCOCK. *Tables for the Determination of Minerals by their Physical Properties*: E. B. MATHEWS. *Duhem's Traité élémentaire de mécanique chimique*: WILDER D. BANCROFT. *Trigonometry for Beginners*: J. B. CHITTENDEN..621
Scientific Journals:—
The Astrophysical Journal.....628
Societies and Academies:—
The Biological Society of Washington: F. A. LUCAS. *Zoological Club of the University of Chicago*: C. M. CHILD. *Torrey Botanical Club*: E. S. BURGESS. *Boston Society of Natural History*: SAMUEL HENSHAW. *The Academy of Science of St. Louis*: WM. TRELEASE. *Science Club of the University of Wisconsin*: WM. S. MARSHALL...629

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

SYLVESTER.

ON Monday, March 15, 1897, in London, where, September 3, 1814, he was born, died the most extraordinary personage for half a century in the mathematical world.

James Joseph Sylvester was second wrangler at Cambridge in 1837. When we recall that Sylvester, Wm. Thomson, Maxwell, Clifford, J. J. Thomson were all second wranglers, we involuntarily wonder if any senior wrangler except Cayley can be ranked with them.

Yet it was characteristic of Sylvester that not to have been first was always bitter to him.

The man who beat him, Wm. N. Griffin, also a Johnian, afterwards a modest clergyman, was tremendously impressed by Sylvester, and honored him in a treatise on optics where he used Sylvester's first published paper, 'Analytical development of Fresnel's optical theory of crystals,' *Philosophical Magazine*, 1837.

Sylvester could not be equally generous, and explicitly rated above Griffin the fourth wrangler George Green, justly celebrated, who died in 1841.

Sylvester's second paper, 'On the motion and rest of fluids,' *Phil. Mag.*, 1838 and 1839, also seemed to point to physics.

In 1838 he succeeded the Rev. Wm. Ritchie as professor of natural philosophy in University College, London.

His unwillingness to submit to the re-

ligious tests then enforced at Cambridge and to sign the 39 articles not only debarred him from his degree and from competing for the Smith's prizes, but, what was far worse, deprived him of the Fellowship morally his due. He keenly felt the injustice.

In his celebrated address at the Johns Hopkins University his denunciation of the narrowness, bigotry and intense selfishness exhibited in these compulsory creed tests, made a wonderful burst of oratory. These opinions were fully shared by De Morgan, his colleague at University College. Copies I possess of the five examination papers set by Sylvester at the June examination, session of 1839–40, show him striving as a physicist, but it was all a false start. Even his first paper shows he was always the Sylvester we knew. To the 'Index of Contents' he appends the characteristic note: "Since writing this index I have made many additions more interesting than any of the propositions here cited, which will appear toward the conclusion." Ever he is borne along helpless but ecstatic in the ungovernable flood of his thought.

A physical experiment never suggests itself to the great mental experimenter. Cayley once asked for his box of drawing instruments. Sylvester answered, "I never had one." Something of this irksomeness of the outside world, the world of matter, may have made him accept, in 1841, the professorship offered him in the University of Virginia.

On his way to America he visited Rowan Hamilton at Dublin in that observatory where the maker of quaternions was as out of place as Sylvester himself would have been. The Virginians so utterly failed to understand Sylvester, his character, his aspirations, his powers, that the Rev. Dr. Dabney, of Virginia, has seriously assured me that Sylvester was actually deficient in intellect, a sort of semi-idiotic calculating boy. For the sake of the contrast, and to show the sort of civilization in which this genius had risked himself, two letters from Sylvester's tutors at Cambridge may here be of interest.

The great Colenso, Bishop of Natal, previously Fellow and Tutor of St. John's College, writes: "Having been informed that my friend and former pupil, Mr. J. J. Sylvester, is a candidate for the office of professor of mathematics, I beg to state my high opinion of his character both as a mathematician and a gentleman.

"On the former point, indeed, his degree of Second Wrangler at the University of Cambridge would be, in itself, a sufficient testimonial. But I beg to add that his powers are of a far higher order than even that degree would certify."

Philip Kelland, himself a Senior Wrangler, and then professor of mathematics in the University of Edinburgh, writes: "I have been requested to express my opinion of the qualifications of Mr. J. J. Sylvester, as a mathematician."

"Mr. Sylvester was one of my private pupils in the University of Cambridge, where he took the degree of Second Wrangler. My opinion of Mr. Sylvester then was that in originality of thought and acuteness of perception he had never been surpassed, and I predicted for him an eminent position among the mathematicians of Europe. My anticipations have been verified. Mr. Sylvester's published papers manifest a depth and originality which entitles them to the high position they occupy in the field of scientific discovery. They prove him to be a man able to grapple with the most difficult mathematical questions and are satisfactory evidence of the extent of his attainments and the vigor of his mental powers."

The five papers produced in this year, 1841, before Sylvester's departure for Virginia, show that now his key-note is really struck. They adumbrate some of his greatest discoveries.

They are: 'On the relation of Sturm's auxiliary functions to the roots of an algebraic equation,' British Assoc. Rep. (pt. 2), 1841; 'Examples of the dialytic method of elimination as applied to ternary systems of equations,' Camb. M. Jour. II., 1841; 'On the amount and distribution of multiplicity in an algebraic equation,' Phil. Mag. XVII., 1841; 'On a new and more general theory of multiple roots,' Phil. Mag. XVIII., 1841; 'On a linear method of eliminating between double, treble and other systems of algebraic equations,' Phil. Mag. XVIII., 1841; 'On the dialytic method of elimination,' Phil. Mag. XXI., Irish Acad. Proc. II.

This was left behind in Ireland, on the way to Virginia. Then suddenly occurs a complete stoppage in this wonderful productivity. Not one paper, not one word, is dated from the University of Virginia. Not until 1844 does the wounded bird begin again feebly to chirp, and indeed it is a whole decade before the song pours forth again with mellow vigor that wins a waiting world.

Disheartening was the whole experience; but the final cause of his sudden abandonment of the University of Virginia I gave in an address entitled 'Original Research and Creative Authorship the Essence of University Teaching,' printed in SCIENCE, N. S., Vol. I., pp. 203–7, February 22, 1895.

On the return to England with heavy heart and dampened ardor he takes up for his support the work of an actuary and then begins the study of law. In 1847 we find him at 26 Lincoln's Inn Fields, 'eating his terms.' On November 22, 1850, he is called to the bar and practices conveyancing.

But already in his paper dated August 12, 1850, we meet the significant names Boole, Cayley, and harvest is at hand.

The very words which must now be used to say what had already happened and what was now to happen were not then in existence. They were afterward made by Sylvester and constitute in themselves a tremendous contribution. As he himself says: "Names are, of course, all important to the progress of thought, and the invention of a really good name, of which the want, not previously perceived, is recognized, when supplied, as having ought to be felt, is entitled to rank on a level in importance with the discovery of a new scientific theory."

Elsewhere he says of himself: "Perhaps I may without immodesty lay claim to the appellation of the Mathematical Adam, as I believe that I have given more names (passed into general circulation) to the creatures of the mathematical reason than all the other mathematicians of the age combined."

In one year, 1851, Sylvester created a whole new continent, a new world in the universe of mathematics. Demonstration of its creation is given by the Glossary of new Terms which he gives in the *Philosophical Transactions*, Vol. 143, pp. 543–548.

Says Dr. W. Franz Meyer in his exceedingly valuable Bericht über die Fortschritte der projectiven Invariantentheorie, the best history of the subject (1892):

"Als äusseres Zeichen für den Umfang der vorgeschrittenen Entwickelung mag die ausgedehnte, grösstenteils von *Sylvester* selbst herrührende Terminologie dienen, die sich am Ende seiner grossen Abhandlung über Sturm'sche Functionen (1853) zusammengestellt findet."

Using then this new language, let us briefly say what had happened in the decade when Sylvester's genius was suffering from its Virginia wound. The birth-day of the giant *Theory of Invariants* is April 28, 1841, the date attached by George Boole to a paper in the Cambridge *Mathematical Journal* where he not only proved the invariantive property of discriminants generally, but also gave a simple principle to

form simultaneous invariants of a system of two functions. The paper appeared in November, 1841, and shortly after, in February, 1842, Boole showed that the polars of a Form lead to a broad class of covariants. Here he extended the results of the first article to more than two Forms. Boole's papers led Cayley, nearly three years later (1845), to propose to himself the problem to determine *a priori* what functions of the coefficients of an equation possess this property of invariance, and he discovered its possession by other functions besides discriminants, for example the quadrinvariants of binary quantics, and in particular the invariant S of a quartic.

Boole next discovered the other invariant T of a quartic and the expression of the discriminant in terms of S and T. Cayley next (1846) published a symbolic method of finding invariants. Early in 1851 Boole reproduced, with additions, his paper on Linear Transformations; then at last began Sylvester. He always mourned what he called 'the years he lost fighting the world'; but, after all, it was he who made the Theory of Invariants.

Says Meyer: "sehen wir in dem Cyklus *Sylvester*'scher Publicationen (1851–1854) bereits die Grundzüge einer allgemeinen Theorie erstehen, welche die Elemente von den verschiedenartigsten Zweigen der späteren Disciplin umfasst." "Sylvester beginnt damit, die Ergebnisse seiner Vorgänger unter einem einzigen Gesichtspunkte zuvereinigen."

With deepest foresight Sylvester introduced, together with the original variables, those dual to them, and created the theory of contravariants and intermediate forms. He introduced, with many other processes for producing invariantive forms, the principle of mutual differentiation.

Hilbert attributes the sudden growth of the theory to these processes for producing and handling invariantive creatures. "Die Theorie dieser Gebilde erhob sich, von speciellen Aufgaben ausgehend, rasch zu grosser Allgemeinheit—dank vor Allem dem Umstande, dass es gelang, eine Reihe von besonderen der Invariantentheorie eigenthümlichen Prozessen zu entdecken, deren Anwendung die Aufstellung und Behandlung invarianter Bildungen beträchtlich erleichterte."

"Was die Theorie der algebraischen Invarianten anbetrifft so sind die ersten Begründer derselben, *Cayley* und *Sylvester*, zugleich auch als die Vertreter der naiven Periode anzusehen: an der Aufstellung der einfachsten Invariantenbildungen und an den eleganten Anwendungen auf die Auflösung der Gleichungen der ersten 4 Grade hatten sie die unmittelbare Freude der ersten Entdeckung." It was Sylvester alone who created the theory of canonic forms and proceeded to apply it with astonishing power. What marvelous mass of brand new being he now brought forth!

Moreover he trumpeted abroad the eruption. He called for communications to himself in English, French, Italian, Latin or German, so only the 'Latin character' were used.

From 1851 to 1854 he produces forty-six different memoirs. Then comes a dead silence of a whole year, broken in 1856 by a feeble chirp called 'A Trifle on Projectiles."

What has happened? Some more 'fighting the world.' Sylvester declared himself a candidate for the vacant professorship of geometry in Gresham College, delivered a probationary lecture on the 4th of December, 1854, and was ignominiously 'turned down.' Let us save a couple of sentences from this lecture:

"He who would know what geometry is must venture boldly into its depths and learn to think and feel as a geometer. I believe that it is impossible to do this, to study geometry as it admits of being stud-

ied, and I am conscious it can be taught, without finding the reasoning invigorated, the invention quickened, the sentiment of the orderly and beautiful awakened and enhanced, and reverence for truth, the foundation of all integrity of character, converted into a fixed principle of the mental and moral constitution, according to the old and expressive adage '*abeunt studia in mores.*'"

But this silent year concealed still another stunning blow of precisely the same sort, as bears witness the following letter from Lord Brougham to The Lord Panmure:

"BROUGHAM,

PRIVATE. 28 Aug. 1855.

MY DEAR P.

My learned excellent friend and brother mathematician Mr. Sylvester is again a candidate for the professorship at Woolwich on the death of Mr. O'Brian who carried it against him last year.

I entreat once more your favorable consideration of this eminent man who has already to thank you for your great kindness.

Yours sincerely

H. BROUGHAM.

On this third trial, backed by such an array of credentials as no man ever presented before, he barely scraped through, was appointed professor of mathematics at the Royal Military Academy, and served at Woolwich exactly 14 years, 10 months and 15 days.

A single sentence of his will best express his greatest achievement there and his manner of exit thence:

"If Her Most Gracious Majesty should ever be moved to recognize the palmary exploit of the writer of this note in the field of English science as having been the one successfully to resolve a question and conquer an algebraical difficulty which had exercised in vain for two centuries past, since the time of Newton, the highest mathematical intellects in Europe (Euler Lagrange, Maclaurin, Waring among the number), by conferring upon him some honorary distinction in commemoration of the deed, he will crave the privilege of being allowed to enter the royal presence, not covered, like De Courcy, but barefooted, with rope around his waist, and a *goose*-quill behind his ear, in token of repentant humility, and as an emblem of convicted simplicity in having once supposed that on such kind of success he could found any additional title to receive fair and just consideration at the hands of Her Majesty's Government when quitting his appointment as public professor at Woolwich under the coercive operation of a non-Parliamentary retrospective and utterly unprecedented War Office enactment." Athenæum Club, January 31, 1871. Of course this means a row of barren years, 1870, 1871, 1872, 1873.

The fortunate accident of a visit paid Sylvester in the autumn of 1873 by Pafnuti Lvovich Chebyshev, of the University of St. Petersburg, reawakened our genius to produce in a single burst of enthusiasm a new branch of science.

On Friday evening, January 23, 1874, Sylvester delivered at the Royal Institution a lecture entitled 'On Recent Discoveries in Mechanical Conversion of Motion," whose ideas, carried on by two of his hearers, H. Hart and A. B. Kempe, have made themselves a permanent place even in the elements of geometry and kinematics. A synopsis of this lecture was published, but so curtailed and twisted into the third person that the life and flavor are quite gone from it. I possess the unique manuscript of this epoch-making lecture as actually delivered. A few sentences will show how characteristic and inimitable was the original form:

"The air of Russia seems no less favorable to mathematical acumen than to a genius for fable and song. Lobacheffsky, the first to mitigate the severity of the Euclidean code and to beat down the bars

of a supposed adamantine necessity, was born (a Russian of Russians), in the government of Nijni Novgorod; Tchebicheff [Chebyshev], the prince and conqueror of prime numbers, able to cope with their refractory character and to confine the stream of their erratic flow, their progression, within algebraic limits, in the adjacent circumscription of Moscow; and our own Cayley was cradled amidst the snows of St. Petersburg." [Sylvester himself contracted Chebyshev's limits for the distribution of primes.] "I think I may fairly affirm that a simple direct solution of the problem of the duplication of the cube by mechanical means was never accomplished down to this day. I will not say but that, by a merciful interpretation of his oracle, Apollo may have put up with the solution which the ancient geometers obtained by means of drawing two parabolic curves; but of this I feel assured that had I been then alive, and could have shown my solution, which I am about to exhibit to you, Apollo would have leaped for joy and danced (like David before the ark), with my triple cell in hand, in place of his lyre, before his own duplicated altar."

That in the very next year Sylvester was taking a more active part than has hitherto been known in the organization of the incipient Johns Hopkins University is seen from the following letter to him in London from the great Joseph Henry:

SMITHSONIAN INSTITUTION,
August 25, 1875.

MY DEAR SIR:

Your letter of the 13th inst. has just been received and in reply I have to say that I have written to President Gilman of the Hopkins University giving my views as to what it ought to be and have stated that if properly managed it may do more for the advance of literature and science in this country than any other institution ever established; it is entirely independent of public favor and may lead instead of following popular opinion.

I have advised that liberal salaries be paid to the occupants of the principal chairs and that to fill them the best men in the world who can be obtained should be secured.

I have mentioned your name prominently as one of the very first mathematicians of the day; what the result will be, however, I can not say.

The Trustees are all citizens of Baltimore and among them I have some personal friends; the President, Mr. Gilman, and one of them, came to Washington a few weeks ago to get from me any suggestions that I might have to offer.

It is to be regretted that in this country the Trustees, who control the management of bequests of this character, think it important to produce a palpable manifestation of of the institution to be established by spending a large amount of the bequest in architectural displays. Against this custom I have protested and have asserted that if the proper men and the necessary implements of instruction are provided, the teaching may be done in log cabins.

It would give me great pleasure to have you again as my guest, and I will do what I can to secure your election. Very truly your friend,

JOSEPH HENRY.

We know the result.

Sylvester was offered the place; demanded a higher salary; won; came.

I was his first pupil, his first class, and he always insisted that it was I who brought him back to the Theory of Invariative Forms. In a letter to me of September 24, 1882, he writes: "Nor can I ever be oblivious of the advantage which I derived from your well-grounded persistence in inducing me to lecture on the Modern Algebra, which had the effect of bringing my mind back to this subject, from which it had for some time previously been withdrawn, and in which I have been laboring, with a success which has considerably exceeded my anticipations, ever since."

He made this same statement at greater length in his celebrated address at the Johns Hopkins on February 22, 1877: "At this moment I happen to be engaged in a research of fascinating interest to myself, and which, if the day only responds to the promise of its dawn, will meet, I believe, a sympathetic response from the professors of our divine algebraical art wherever scattered through the world.

"There are things called Algebraical Forms; Professor Cayley calls them Quantics. These are not, properly speaking, Geometrical Forms, although capable, to some extent, of being embodied in them, but rather schemes of processes, or of operations for forming, for calling into existence, as it were, algebraic quantities.

"To every such Quantic is associated an infinite variety of other forms that may be regarded as engendered from and floating, like an atmosphere, around it; but infinite in number as are these derived existences, these emanations from the parent form, it is found that they admit of being obtained by composition, by mixture, so to say, of a certain limited number of fundamental forms, standard rays, as they might be termed, in the Algebraic Spectrum of the Quantic to which they belong; and, as it is a leading pursuit of the physicists of the present day to ascertain the fixed lines in the spectrum of every chemical substance, so it is the aim and object of a great school of mathematicians to make out the fundamental derived forms, the Covariants and Invariants, as they are called, of these Quantics.

"This is the kind of investigation in which I have, for the last month or two, been immersed, and which I entertain great hopes of bringing to a successful issue.

"Why do I mention it here? It is to illustrate my opinion as to the invaluable aid of teaching to the teacher, in throwing him back upon his own thoughts and leading him to evolve new results from ideas that would have otherwise remained passive or dormant in his mind.

"But for the persistence of a student of this university in urging upon me his desire to study with me the modern algebra I should never have been led into this investigation; and the new facts and principles which I have discovered in regard to it (important facts, I believe) would, so far as I am concerned, have remained still hidden in the womb of time. In vain I represented to this inquisitive student that he would do better to take up some other subject lying less off the beaten track of study, such as the higher parts of the Calculus or Elliptic Functions, or the theory of Substitutions, or I wot not what besides. He stuck with perfect respectfulness, but with invincible pertinacity, to his point. He would have the New Algebra (Heaven knows where he had heard about it, for it is almost unknown on this continent), that or nothing. I was obliged to yield, and what was the consequence? In trying to throw light upon an obscure explanation in our text-book my brain took fire; I plunged with requickened zeal into a subject which I had for years abandoned, and found food for thoughts which have engaged my attention for a considerable time past, and will probably occupy all my powers of contemplation advantageously for several months to come."

Another specific instance of the same thing he mentions in his paper, 'Proof of the Hitherto Undemonstrated Fundamental Theorem of Invariants,' dated November 13, 1877:

"I am about to demonstrate a theorem which has been waiting proof for the last quarter of a century and upwards. It is the more necessary that this should be done, because the theorem has been supposed to lead to false conclusions, and its correctness has consequently been impugned. Thus in Professor Faà de Bruno's valuable *Théorie des formes binaires*, Turin, 1876, at the foot of page 150 occurs the following passage: "Cela suppose essentiellement que les équations de condition *soient toutes indépendantes entr'elles, ce qui n'est pas toujours le cas*, ainsi qu'il résulte des recherches du Professor Gordan sur les nombres des covariants des formes quintique et sextique."

The reader is cautioned against supposing that the consequence alleged above does

result from Gordan's researches, which are indubitably correct. This supposed consequence must have arisen from a misapprehension, on the part of M. de Bruno, of the nature of Professor Cayley's rectification of the error of reasoning contained in his second memoir on Quantics, which had led to results discordant with Gordan's. Thus error breeds error, unless and until the pernicious brood is stamped out for good and all under the iron heel of rigid demonstration. In the early part of this year Mr. Halsted, a fellow of John's Hopkins University, called my attention to this passage in M. de Bruno's book; and all I could say in reply was that 'the extrinsic evidence in support of the independence of the equations which had been impugned rendered it in my mind as certain as any fact in nature could be, but that to reduce it to an exact demonstration transcended, I thought, the powers of the human understanding.'"

In 1883 Sylvester was made Savilian professor of geometry at Oxford, the first Cambridge man so honored since the appointment of Wallis in 1649.

To greet the new environment, he created a new subject for his researches—Reciprocants, which has inspired, among others, J. Hammond, of Oxford; McMahon, of Woolwich; A. R. Forsyth, of Cambridge; Leudesdorf, Elliott and Halphen.

Sylvester never solved exercise problems such as are proposed in the *Educational Times*, though he made them all his life long down to his latest years. For example, *unsolved* problems by him will be found even in Vol. LXII. and Vol. LXIII. of the *Educational Times* reprints (1895). If at the time of meeting his own problem he met also a neat solution he would communicate them together, but he never solved any. In the meagre notices that have been given of Sylvester the strangest errors abound. Thus C. S. Pierce, in the *Post*, March 16th, speaks of his accepting, 'with much diffidence,' a word whose meaning he never knew; and gives 1862 as the date of his retirement from Woolwich, which is eight years wrong, as this forced retirement was July 31, 1870, after his 55th birthday. Cajori, in his inadequate account (History of Mathematics, p. 326), puts the studying of law before the professorship at University College and the professorship at the University of Virginia, both of which it followed. Effect must follow cause. And strange, that of the few things he ascribes to Sylvester, he should have hit upon something not his, "the discovery of the partial differential equations satisfied by the invariants and covariants of binary quantics." But Sylvester has explicitly said in Section VI. of his 'Calculus of Forms:' "I alluded to the partial differential equations by which every invariant may be defined. M. Aronhold, as I collect from private information, was the first to think of the application of this method to the subject; but it was Mr. Cayley who communicated to me the equations which define the invariants of functions of two variables."

Surely he needs nothing but his very own, this marvellous man who gave so lavishly to every one devoted to mathematics, or, indeed, to the highest advance of human thought in any form.

George Bruce Halsted.
University of Texas.

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*THE GREAT FAULT AND ACCOMPANYING SANDSTONE DIKES OF UTE PASS, COLORADO.**

Three year years ago Whitman Cross first directed the attention of geologists to the fact that dike-like masses of sandstone occur in the granite of the Pike's Peak massif, forming a belt about one mile wide extending north-northwest from the vicinity of Green Mountain Falls, in Ute Pass,

*Abstract of a paper read before the Boston Society of Na al History, January 20, 1897.

along the southwest side of the narrow Manitou Park, basin of sedimentary rocks (Silurian and Carboniferous). Among the more important characteristics of the dikes noted by Cross are the following: 1. The dikes have a general trend parallel to the belt in which they occur; are approximately vertical and often appear as a complex of nearly parallel fissures with many branches and connecting arms; and vary in width from mere films to two or three hundred yards, the largest being a mile or more in length, and forming rugged ridges with narrow crests which contrast markedly with the gentle sloping hills of granite about them. In short, "In all formal relationships to the enclosing rocks these bodies are as typical dikes as any of igneous origin." 2. The rock of the dikes is a fine and even-grained aggregate of sand grains varying in degree of induration from a normal sandstone to a dense hard quartzite, but throughout of a remarkably massive and uniform character.

During the past summer of 1896 I was able to devote several weeks to the investigation of the sandstone dikes and the great displacement to which I have found them to be genetically related. To the dikes described by Cross I gave only sufficient attention to become familiar with their characteristics, and then endeavored to trace the series southeastward through Ute Pass to Manitou and beyond.

The sedimentary formations of the Manitou area embrace, from below upward, as described by Hayden, Cross and others: 1. A basal sandstone which is usually 40 to 50 feet thick, white or gray for the lower 10 to 15 feet and dull red or brown above, only rarely of arkose character, but frequently more or less glauconitic. 2. This sandstone, which may be referred provisionally to the Potsdam, becomes calcareous upward, passing into red, cherty limestones, and these into a massive gray limestone having a thickness of several hundred feet. The limestones are throughout more or less magnesian and contain recognizable traces of a Lower Silurian (Ordovician) fauna. 3. This great Manitou limestone series is overlain without apparent unconformity by the Fountain (Carboniferous) beds 1,000 to possibly 1,500 feet in thickness—a remarkable complex of red and white arkose sandstone, grits and conglomerates. 4. The red sandstone series (Triassic), a thousand feet or more in thickness. 5. The white, variegated and gypsiferous Jurassic strata. 6. The Cretaceous series, beginning with the massive and conspicuous Dakota sandstone.

Each of these formations is cut off on the south by the great fault which skirts the northeastern base of the Pike's Peak massif. This profound displacement, which must be regarded as a dominant factor in the geological structure of the region, and to which we undoubtedly owe, in the main, the Manitou embayment of sedimentary rocks and the exceptional elevation of the Pike's Peak massif as compared with the Front Range to the north of Ute Pass, gained early recognition and is clearly indicated on Hayden's maps of the Manitou area. It is altogether probable that the fault by which Cross has bounded the Manitou Park sediments (Potsdam, Manitou limestone, and Fountain series) on the southwest is a direct continuation of that which, cutting across the strike of the beds, is so much more conspicious in the Manitou area. This great displacement, which divides very obliquely the entire Front Range and the beds lying upon either flank of the range and sloping away from its crest, may therefore be appropriately designated the Ute fault. Erosion has cut deeply enough over the top of the arch to remove the sedimentary rocks from the down-throw as well as the up-throw side of the fault. The Ute fault cuts every formation of the region from the fundamental

granite and the Potsdam to the Laramie, and in its maximum throw must exceed the aggregate thickness of the Paleozoic and Mesozoic terranes; and its completion, at least, must date from relatively late geological times.

I have succeeded in tracing the sandstone dikes from the vicinity of the Iron Spring, in Manitou, northwest along the great fault two miles, or a little farther than the sedimentary rocks extend, and southeastward from Manitou, along the base of the mountains, and closely following the Ute fault, to Cheyenne Cañon and beyond, a distance of six miles. The dikes of this series vary in width up to 500 or 600 feet. A large dike usually follows the main line of displacement, separating the sedimentary rocks and granite, with one to several other dikes closely parallel with it in the granite. Almost without exception the dikes exhibit a strong southwesterly hade, making angles of 5 to 75 degrees with the vertical, and slickensided shear planes at corresponding angles are very common. Although the rock is prevailingly a fine and even-grained gray and reddish-brown sandstone, identical with that described by Cross, much of it is decidedly coarser, and at several points it is distinctly conglomeratic. In several dikes, also, the sandstone is more or less distinctly stratified.

Mr. Cross has briefly discussed the origin of the sandstone dikes, without arriving at a definite conclusion. He recognizes that these sandstone dikes are radically distinct in character and origin from those described by Diller in California, and asserts that the known facts do not indicate the source of the sand; that the facts do show that the fissures of this dike complex were filled by fine quicksand injected from a source containing a large amount of homogeneous material; that such a system of fissures, large and small, with their many intersections, could not remain open to be filled by any slow process; that the uniformity and purity of the material filling fissures varying from mere films on cleavage planes of orthoclase grains in the granite to dikes several hundred yards in width could not have resulted from infiltration; and, finally, that none of the sedimentary formations of the region can be regarded as probable sources of the material.

My study enables me to accept all of these generalizations, except the last one. The most important of the facts which the true theory of the dikes must explain are: first, their very evident close relationship to an important zone of displacement; second, the homogeneity of the materials and the general absence of stratification in the dikes; third, the great maximum and average widths of the dikes.

The relations of the dikes to the great Ute fault are indisputable. Not only is the fault at most points closely accompanied by one or more dikes; but nowhere have I been able to find any trace of the dikes more than a few hundred feet (500 to 1,000 feet) distant from the principle line of displacement. That these fissures, unlike the relatively narrow ones described by Diller in California, have not been filled from below becomes perfectly obvious when we reflect that the inclosing rock formation is a deep-seated plutonic. The homogeneity and purity of the sandstone, and especially the absence of feldspathic or argillaceous material, make it impossible to regard the dike rock as a fault breccia or as due in any way to the comminution of the wall rock. Ruling out this theory and infiltration, we are forced to the conclusion that the fissures have been filled from above. But of this theory two principal forms naturally suggest themselves. First, the fissures antedate the deposition of the sand, existing as cracks in the sea-botton which were filled by the slow process of sedimenta-

tion. Second, the cracks post-date the deposition of the sand, but antedate its lithification to form a firm sandstone and the unconsolidated sand subsided and flowed down into and filled the fissures.

By this process of elimination we are forced to the consideration of the view that the fissures were formed after the granite had been covered by the sedimentary deposits and before their complete consolidation, the unconsolidated portions naturally contributing to the filling of the fissures and the formation of the dikes. There are two questions especially which the acceptance of this explanation would require to be answered in the affirmative. First, are there, among the sediments of the Manitou and Manitou Park basins, any that, aside from structural features like stratification, which would, of course, be obliterated during the filling of the fissures, present a reasonably close agreement in character (composition and texture) with the sandstone of the dikes? Second, may we reasonably assume that these sediments were, in part at least, unconsolidated or imperfectly consolidated at the time when the fissures were formed? The only sandstone formations that need be considered in this connection are the Potsdam, Carboniferous, Triassic and Dakota. Of these four sandstone horizons the last three bear no special resemblance to the material of the sandstone dikes. On the other hand, I became convinced before the field work was finished that the Potsdam beds and the dikes are lithologically identical. The dike rock is absolutely indifferent to the changes in the character of the neighboring formations, showing no appreciable variation, as in succession, from Manitou southeast to Cheyenne Cañon, the Potsdam, Silurian, Carboniferous, Triassic and Dakota beds abut against or border the great fault.

The close association of the dikes, throughout the entire belt, with the great displacement, and their unvarying lithological similarity to the Potsdam sandstone, have suggested to me that the dikes probably date from the formation of the Ute fault; that the fault probably dates from the time when the Potsdam beds, which are still, at the base, in part of a more or less friable character, were imperfectly consolidated and covered the entire region; that the fault, as is likely to be the case with a great displacement, was not simple, but that a moderate breadth of the granite and overlying formations was traversed by a series of parallel fissures; and that the dikes resulted from the sinking of the Potsdam sandstone and sand into the fault fissures. Such local subsidences of the friable sandstone would naturally be attended by a more or less complete obliteration of the bedding.

No single feature of the dikes is more significant than the great breadth of individual examples. Although presenting, apparently, an insuperable obstacle to all the other suggested explanations of the sandstone dikes, it offers no difficulty whatever to the theory proposed here, for we have only to make the extremely probable supposition that sheets of granite of varying width and bordered by complementary faults have settled down relatively to the bordering masses, bearing with them their loads of Potsdam sediment.

W. O. CROSBY.

EXHIBITION IN SCIENCE BY THE NEW YORK ACADEMY OF SCIENCES.

THE Fourth Annual Exhibition of Recent Progress in Science, given by the New York Academy of Sciences, was held at the American Museum of Natural History on April 5th and 6th, and was in every way the most successful in the history of the Society. The exhibit occupied the floor space of the main hall and bird gallery, and was attended by an estimated number of more

than three thousand people. The first evening was devoted to a reception to the members of the Academy and a few invited guests, and was more or less social in its nature. On the afternoon of the second day the visitors included many from the public and private schools of city who were especially invited. On the second evening the reception was to members of the Scientific Alliance and other friends, and the occasion was more informal and public than on the previous evening.

Besides the Exhibition, the committee had planned a program of considerable interest, for the second evening, including a short informal talk by Dr. Nicola Tesla on 'The Streams of Lenard and Röntgen.' Dr. Tesla gave a short synopsis of some of his more recent discoveries and exhibited several pieces of apparatus for producing high power, electrical currents with simple machines. This talk was preceded by a short review of the scientific results of the year by Professor J. J. Stevenson, President of the Academy, and an address of welcome by Mr. Morris K. Jesup, President of the Museum, to whose courtesy and hospitality much of the success of the occasion was due.

In every way the success of the Exhibition was very great and very encouraging to workers in science, for the manifest interest of the large numbers of people attending was a striking sign of the times. Interest, and not popular curiosity, attracted the greater number of visitors. The attention that the Exhibition was given both by people of New York and the newspapers showed that this annual feature of the Academy is fast becoming one of the occasions of the year to which many people look forward with very great anticipation.

The reception was in charge of a committee of Professor Henry F. Osborn, Mr. Charles F. Cox and Professor Richard E. Dodge. They were assisted in the planning of the details and in the execution thereof by a committee of one from each department represented, of which a list follows: Anatomy, Professor George S. Huntington; Astronomy, Professor J. K. Rees; Botany, Professor L. M. Underwood; Chemistry, Professor Chas. A. Doremus; Electricity, Mr. George F. Sever; Ethnology and Archæology, Mr. Franz Boas and Mr. M. H. Saville; Experimental Psychology, Professor J. McK. Cattell; Geology, Professor J. F. Kemp; Mineralogy, Mr. George F. Kunz; Paleontology, Mr. Gilbert van Ingen; Photography, Professor William Stratford; Physics, Professor William Hallock and Professor J. F. Woodhull; Physiography, Professor R. E. Dodge; Zoölogy, Professor C. L. Bristol and Mr. Bashford Dean.

The exhibits that received the most attention were naturally those concerning which there has been the most said publicly within the last year. The electric furnaces, including the one used by Dr. Henri Moissan in his lectures before the Academy; the outfits for illustrating the uses and effects of the Röntgen rays, and the instruments of fatigue in experimental psychology were continually surrounded by a large number of interested listeners and spectators.

Inasmuch as the Exhibition was arranged to show progress during the last year only, there were few duplications of former exhibits in any department. Everything shown was in a way new and received attention in proportion to its importance. The chairmen of the departments were in attendance during most of the time and gladly answered questions and explained particular points of interest. In this way the visitors felt that they were guests rather than sightseers. Nothing of an advertising character was allowed, and hence the air of the whole Exhibition was serious and truly scientific.

Besides the exhibits that were mentioned

above as being the most attentively studied, there were many other exhibits worthy of mention, of which only a few can be spoken of here. In chemistry, besides the exhibits noted, the most interesting materials were the artistic glasses exhibited by the Tiffany Decorative Company, and several striking pieces of apparatus exhibited by the chairman.

In electricity the enclosed arc lamps, the Crookes tubes and fluoroscopes received a great deal of attention. In ethnology and archæology the busts of the Kwakiutl Indians and the paintings, diagrams and specimens illustrating the culture of the primitive American races were the more notable exhibits.

In geology the exhibit of clays from various parts of America and the products made therefrom won a great deal of well deserved attention. The photographs from the Cornell Greenland expedition illustrating some of the conclusions of Professor Tarr regarding the effects of glaciers in Greenland were of interest both to the unscientific and the scientific. The associated subject mineralogy had on exhibition a large series of new and valuable specimens which cannot be noted here in detail. In paleontology was one of the largest exhibits that took the greatest amount of labor in arranging. The exhibit included fossils from some of the more important localities illustrating the work accomplished by leading paleontologists of the East. Besides the stratigraphic collections exhibited, there was a large series of fossil insects from Florissant, Colorado, including some very handsome butterflies exhibited by Mr. S. H. Scudder. The preparations of Beecher, of Yale University, illustrating the structures of Trilobites, were much studied, representing, as they do, the best knowledge of what has been until recently but little known. The fossil gums including insects of all kinds also deserve a note. In vertebrate paleontology there was a large collection of fossils from the American Museum, and some striking water colors of the reproductions of extinct mammalia.

The exhibit in photography included some very beautiful prints and some of the more recent apparatus, and received much attention. It was, however, disappointing to those in charge because so many exhibitors failed to send promised materials, some of which were of especial interest and value.

In physiography the exhibit included several large models of New England and New York, representing the newest and best work of Mr. Howell, of Washington. A series of teaching models from Professor W. M. Davis, which have just been cast, also were exhibited uncolored. These models represent the best work of the year outside of the numerous publications.

In zoology the most important exhibition was the collection of animals from the Puget Sound region, exhibited by Columbia University. Many of the forms represented were shown in all stages from embryonic to adult and are very valuable additions to our knowledge of the lower animals. The plans and models of the new Zoological Park of New York City also were shown in some detail and naturally received very much attention.

The Exhibition represents a large investment of time and labor on the part of the few in charge, and should bring very valuable results to the Academy in many ways. It has aroused considerable interest in many places at a distance from the city, and it is hoped that the plan of having such exhibitions may be followed by other scientific societies in the country. If scientists would have the support of the public they must show their work. There is no better way to show work than by a scientific exhibition in which the popular and wonderful are exhibited together with the more valuable and enduring. The committee in

charge feel that the investment of time, money and labor has paid for itself, for the interest we have aroused has been an inspiration to all of us and, we think, to many others. It has shown that science has a very strong hold upon the public and that the public appreciate the work of abstruse science, whether or not it shows immediate results from an economic standpoint.

RICHARD E. DODGE.

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*THE MISSOURI BOTANICAL GARDEN.**

DURING the year 1896 the ornamental features of the Garden were of the same general character as heretofore, and about the same number of species and nearly the same of individuals were cultivated for this purpose, in the open air, as in 1895. The house collections, on the other hand, especially that of orchids, have been considerably increased, both in size and variety. A conservative estimate by the Head Gardener shows that at present about two and one-half times as many species and named varieties of plants are cultivated as in 1889. At the end of 1895 an inventory of the plants in cultivation at the Garden showed that 3921 species and varieties other than annuals were cultivated at that time. During the past year, while considerable additions have been made, it is probable that certain species have dropped out of cultivation, so that in the absence of a special inventory it is possible to state merely that the number now in cultivation is unquestionably somewhat greater than that in 1895.

It is estimated that, for various temporary reasons, the number of visitors to the Garden during 1896 was scarcely as large as in the preceding year. On the open Sunday afternoon in June 10,598 persons passed the gate, and on the corresponding Sunday afternoon in September 13,589 visitors were counted. So far as estimates can be made from the data at hand, the number of visitors to the Garden is now about one-half greater than in 1889, though, as no automatic register of visitors is kept at the gate, the estimates are not accurate.

As a result of the most destructive hail-storm that has ever been experienced at the Garden, some 6,000 lights of glass were broken on tne 21st of May last, the falling glass doing incalculable damage to many of the plants, which were further exposed to the weather for a considerable time. Cacti and other plants which are sheltered under glass during the winter, but which had been placed in the rockeries and elsewhere before the storm, were either destroyed or so badly bruised that it is impossible even yet to count the final loss. Some idea of the force of the falling hail may be obtained from the statement that the ribbed glass on the roof of the Linnæan house, nearly a quarter of an inch thick, was in considerable part broken.

Closely following this storm, the tornado of May 27th, which caused great loss of life and property in and about St. Louis, devastated a considerable portion of the Garden. While the grounds, fortunately, were not actually traversed by the cyclonic funnel, but were exposed only to the strong northwest gale which accompanied it, the violence of the wind was such that a number of the structures on the grounds were either unroofed or totally wrecked, while some 450 trees, many of them of large size, were totally or practically destroyed, and a large percentage of those left standing were seriously broken. A more graphic view of the destruction of trees may be obtained from the statement that 186 cords of firewood have been prepared from the more workable trunks and larger branches of the trees removed. Aside from the direct injury, it is probable that no small number of those left have suffered from unwonted ex-

*From advance sheets of the eighth annual report of the Director, Professor Wm. Trelease.

posure to the strong sunlight of last summer and the winds of the present winter, so that many more are almost certain to require removal during the next year or two.

During the period of time covered by this, report the herbarium has increased from 159,046 unmounted specimens, constituting the Engelmann and Bernhardi herbaria, to 258,629 mounted specimens, protected by impregnation with corrosive sublimate. The library, which at first contained considerably less than 5,000 volumes and pamphlets, has increased to 23,257, valued at nearly $40,000.

Notwithstanding the provision of safe and, for the time being, ample quarters for the library and herbarium in the reconstructed city residence, it has not yet been found practicable to remove the numerous wood specimens, and other unattractive but necessary and valuable material, from the old museum building, so as to free the latter for other uses; nor has it proved possible to spare funds for the purchase of material and the salary of an assistant who should be charged with the installation and maintenance of a museum illustrating some branch of pure or applied botany, such as might be accommodated in this small building were it empty.

Aside from an increase in the plant-houses, and the accumulation of books, living and preserved specimens of plants and their parts, and a small collection of insects, no considerable facilities for research have been acquired at the Garden thus far, the instrumental equipment of the School of Botany being found available for all necessary use by the few Garden employees and pupils, and, as yet, no properly equipped permanent laboratory rooms have been provided, adequate temporary provision being made in the herbarium building and the plant-houses for such work as has been undertaken. While in some respects much remains to be done, such facilities as have been secured thus far have been placed at the disposal of investigators, of whom one or more have occupied tables at the Garden for a period of from one month to a year, each season for several years past, three such investigators having been accommodated at the Garden during the current autumn and winter. By direction of the Board, a general announcement is made, by a widely distributed circular, in the early part of each year, that such facilities as the Garden possesses, or can readily acquire for any worthy piece of investigation, are freely placed at the disposal of competent investigators.

THE GANODONTA OR PRIMITIVE EDENTATES WITH ENAMELLED TEETH.

THE discovery of the forefoot of *Psittacotherium* in the upper division of the Puerco beds (New Mexico) is one of the most fortunate accidents in the recent history of paleontology, because of its remarkable likeness to the foot of the sloth. This likeness at once suggested to Dr. J. L. Wortman the relationship of *Psittacotherium* to the Gravigrada, or great Ground Sloths. Upon his return to the American museum from the field the entire collection was placed in his hands, and it soon appeared that a series of animals which had been referred to the Creodonta, to the Tillodontia and to other orders formed in reality a part of a genetic series pointing conclusively toward the modern sloths, especially towards *Megalonyx*. The evidence is summed up in Dr. Wortman's recent paper, as follows:

*(1) In the skull there is great similarity in form; the muzzle is short, the sagittal crest is low, and the occipital plane slopes forwards as in Mylodon, Megatherium and Megalonyx. (2) The lower jaw is short, deep and robust, with a greatly enlarged coronoid, a prominent angle, and a

*'The Ganodonta, and their relationship to the Edentata.' Bull. Am. Mus. Nat. Hist., March 22, 1897.

position of the condyle high above the tooth line. (3) The incisors are reduced to a single pair in the lower jaw of *Calamodon*, and are probably completely absent in *Stylinodon*. (4) The posterior portion of the tooth line below passes well behind the anterior border of the coronoid. (5) The canines in all are enlarged, and in *Calamodon* and *Stylinodon* grew from persistent pulps, as in Megalonyx. (6) All the molars and premolars in *Stylinodon* are greatly elongated, of persistent growth, and the enamel is confined to narrow vertical bands. (7) There is a thick deposit of cementum on the dentine in those situations in which the enamel disappears. (8) The cervical vertebræ strongly resemble those of the Gravigrada. (9) There were well developed clavicles present. (10) The humerus bears a striking resemblance in all of its essential features to those of *Mylodon*, *Megalonyx* and *Megatherium*. (11) The ulna and radius are also similar. (12) The manus is almost identical with that of the ground sloths. (13) The humerus and ulna and radius have no medullary cavities; and (14) the femur has all the characteristic features of the Gravigrada. (15) The lumbar vertebral formula was the same as in the Edentata. (16) The pelvis is decidedly Edentate and (17) the caudals bear a striking resemblance to those of the Ground Sloths."

It follows, or at least is extremely probable, that not only the Gravigrada, but all the South American Edentates had their origin in North America. Thus a group which has been traditionally assigned to South America now appears to have taken its origin in the north, for the sloths first appear in the Santa Cruz beds of Patagonia, which are not older than the North American White River beds or Oligocene, whereas in North America they are found immediately over the Cretaceous. The importance of this discovery can hardly be exaggerated, both because of its bearing upon phylogeny, and upon geographical distribution. It appears certain that there was an early land connection between North and South America, and it is in the highest degree improbable that the sloths found their way to South America by way of Asia and Antarctica, as Lydekker has suggested. This early land connection enables us to connect the South American Ungulates, especially the Litopterna, with the American Condylarthra, as Cope and others have suggested, so that it will throw renewed life into the study of the genetic relations of these northern and southern faunas. Another important result is, that the Edentates are proved to be of tritubercular origin, thus reinforcing the evidence of a trituberculate stem form of all the mammalia.

H. F. O.

CURRENT NOTES ON METEOROLOGY.

THE EXPLORATION OF THE AIR.

In *Appalachia*, Vol. VIII., No. 1, pp. 179–189, Mr. A. L. Rotch has a paper on 'The Exploration of the Free Air,' in which he gives a general outline of the way in which this work is being done, by means of mountain stations, balloons, cloud measurements and kites. The following facts are of general interest: The first summit station in the world was established on Mt. Washington, N. H. (6,280 ft.), in 1870. The Pikes Peak station (14,134 ft.), now closed, was for many years the highest in the world, but at present the highest station is that of the Harvard College Observatory on the summit of the volcano El Misti, in Peru (19,200 ft.). On Mont Blanc there is a station at the Rochers des Bosses (14,320 ft.), operated during the summer, and on the summit (15,780 ft.), the latter still being idle. The Sonnblick (10,170 ft) in the Austrian Alps; the Saentis (8,200 ft) in Switzerland; Monte Cimone (7,100 ft.) in the Apennines, near Lucca, and Ben Nevis (4,400 ft.) in Scot-

land, are the other well-known high altitude stations. Epoch-making balloon ascents were those of Dr. John Jeffries, of Boston, who made the first scientific balloon voyage from London in 1784; Gay Lussac in 1804 (23,000 ft.); Coxwell and Glaisher in 1862 (29,000 ft.), and Crocé-Spinelli, Sivel and Tissandier, in 1875, in which the two former were asphyxiated. In 1894 Berson ascended alone to an altitude of about 30,000 ft., his barometer reading 9.1 inches, and the minimum temperature being –54° Fahr. Pilot balloons, without aëronauts, have ascended over 10 miles on two occasions, the 'Cirrus' in July, 1894, bringing down a barograph reading of 3.3 inches, and a thermograph reading of –64° Fahr.

VISIBILITY OF MOUNTAINS AND ATMOSPHERIC DUST.

A PAPER by Schultheiss, in the *Meteorologische Zeitschrift* for December, discusses a matter of some interest that has not yet been much considered. It concerns the effect of the dust in the atmosphere in relation to the greater or less visibility of distant mountains. Observations on the visibility of the Alps have been made for 20 years past at Höchenschwand, a station in the southern Black Forest, at an altitude of 1,000 meters and commanding, under favorable conditions, an extended view of the Alps as far as Mont Blanc. Three degrees of visibility are noted, designated respectively as 0, 1 and 2, the latter figure denoting the greatest clearness of view. A careful study of the records and of the weather conditions prevailing at the times of observation reveals the fact that the visibility is best under anticyclonic conditions or during the prevalence of a foehn wind. In both cases there is a descending movement of the atmosphere, and as the upper strata are cleaner and purer than the lower this process results in causing greater clearness of the air and hence a higher degree of visibility. Ninety per cent. of all the cases in which the view of the distant Alps was clear are found to be associated with such anticyclonic or foehn conditions. Cleaning the air by means of rain seems to be the controlling factor in the majority of the other 10 per cent. of cases. Naturally, as anticyclones are more frequent and longer-lived over central Europe in winter, the visibility is greater in winter and less in summer. There is a common belief, here as well as in Europe, that very clear days, which give very good views of distant mountains, are most likely to be followed by rain. Schultheiss has investigated this question in the case of the Alps as seen from Höchenschwand, and finds that an especially clear view is seldom closely followed by rain. He also finds that the dust in the atmosphere at 1,000 meters is very fine and does not include large quantities of coarser smoke particles as it does at lower levels.

THE BLUE HILL METEOROLOGICAL OBSERVATORY.

IT is a very great satisfaction to learn from the volume of Blue Hill Observations for 1895 (Annals Harv. Coll. Obs'y, Vol. XL., Pt. V.) that the President and Fellows of Harvard College have secured from the Metropolitan Park Commissioners of Boston a lease of about one and a quarter acres of land on the summit of the Hill. This lease is for ninety-nine years, and will enable the work of the Observatory to be continued without any change in the present conditions of exposure of the instruments. There was some fear, when, a few years ago, the Metropolitan Park Commission added the Blue Hills to the Boston Park system, that the future usefulness of the Observatory might be seriously interfered with by the possible erection of buildings in its vicinity. It would have been a very serious loss to science, not only in this country but in the

world, had anything happened to interfere in any way with the work that the Blue Hill Observatory has been doing so admirably since its foundation. The present volume of observations contains the usual data for the year and, in addition, summaries for the lustrum and decade, with a discussion of the annual and diurnal periods, by Clayton. A number of interesting points are brought out, among them the grouping of thunderstorms around certain dates; the occurrence of maxima in the frequency and amount of snowfall at intervals of twenty or thirty days; of the greatest snowfall in February, and of a minimum of rainfall in June, with a maximum in October.

R. DeC. Ward.

Harvard University.

CURRENT NOTES ON ANTHROPOLOGY.

THE SO-CALLED 'BOW-PULLERS' OF ANTIQUITY.

This is the title of a carefully prepared essay by Professor Edward S. Morse, in the *Essex Institute Bulletin*, Vol. XXVI., the essential facts of which have been copied in *Globus*, Bd. LXXI., No. 10, and other foreign journals. The subject discussed is the purpose of certain objects of bronze or iron found in Greek, Roman and Etruscan tombs. These objects are two connected rings of the metal about seven centimeters in full length, the space between them being about two centimeters, from which space three or four knobs, projections or spines, of irregular height, arise.

Professor Morse proves that these objects can be neither bow-pullers, spear throwers, curbs, bits, caltrops, nor anything else which has been proposed by classical archæologists; but what they are, he says, after seven years' study, he cannot suggest, nor do the European editors who have republished his article offer an explanation. I take, therefore, some special pleasure in solving this enigma, and in identifying this curious and puzzling object. It is without doubt the Greek *myrmex* (*μύρμηξ*) which, in pugilistic encounters, was strapped or chained on the hand over the leathern cestus. This identification answers every condition of form, material, decoration and use mentioned by Professor Morse. I shall shortly publish an article giving the Greek and Latin authorities at length, confirming this opinion.

FAIRYLAND.

In his presidential address, published in *Folk-lore* for March, Mr. Alfred Nutt discusses the origin of the fairy-lore which has been such a prominent feature in English literature and rustic narrative. He brings together many reasons for attributing it to a Celtic source. It is, in fact, a survival of the belief in the pre-Christian, pagan gods of the Celtic tribes. These have been best remembered in Ireland, where they are still spoken of as the *tuatha de Danann*—the folk of the goddess Danu; and they are to this day considered the occupants of the fairy hillocks.

Mr. Nutt does not explain why the fairies were considered very little beings, as this is not mentioned in the earliest Irish myths. I may suggest that there are reasons for believing that the goddess Danu was the moon (from the O. I. verb, *daon*, to arise, to ascend; and compare Harley, *Moon-lore*, p. 121), and her followers, or folk, the little twinkling stars; whence by an easy step of personification they were transformed into the tiny fairy folk.

RECENT ETRUSCOLOGY.

The 'Etruscan problem' is one of perennial interest, and now that the Metropolitan Museum of New York and that of the University of Pennsylvania have acquired large and valuable collections from ancient Etruria, the affinities of its mysterious in-

habitants have an increased attraction for American students.

In the February number of the *Journal of the Anthropological Institute* the eminent antiquary, Dr. Oscar Montelius, offers some new views on the subject. He identifies the Etruscans of Italy with the Tyrrhenians and the Pelasgians, and the earliest Etruscan culture with the Mycenean. Both, he believes, emerged from Asia Minor, the Etruscans reaching Italy by sea about 1050 B. C., bringing with them their peculiar alphabet. The 'Tursha' of the Egyptian inscriptions of the 13th century B. C., he argues, were the Tyrrhenians.

In the discussion which followed, some of these views were opposed by Mr. Arthur Evans and Mr. J. L. Myres, the former maintaining that the 'root elements' of the Mycenean civilization were European and not Asiatic; and the latter referring with approval to the theory that the Etruscans belonged to the Hamitic stock of North Africa, advanced on linguistic grounds by myself.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

A RECENT number of *Nature* (March 11th) contains an interesting review, by T. K. Rose, of the extraction of gold by chemical methods; much of the gold in ores is in a state of very fine division, the particles being often less than one thousandth of an inch in diameter, and sometimes less than one twelve thousandth. Such particles are much more readily dissolved by chemical means than by mercury. In sulfid ores, too, mercury is an unsatisfactory solvent. Such ores have until lately been worked by the chlorination process, which is now nearly fifty years old. The sulfids must, however, be very completely roasted, as the chlorin has a greater preference for sulfids than for the gold. When alkaline earths are present, salt must be added in the roasting. This however occasions, save in the improved furnaces, a loss of chlorid of gold by volatilization. The ore is generally treated with chlorin water in large vats or in revolving barrels under pressure. The plant at Mount Morgan, Queensland, is the largest in the world, 1500 tons of ore being treated at a cost of $4.50 per ton, about $25 in gold being recovered for each ton. The gold is best precipitated from the chlorin solution by hydrogen sulfid, though iron sulfate or charcoal in boiling solution may be used. On account of the expense of roasting and the non-recovery of any silver in the ore, the chlorination process is being gradually superseded by the cyanid process, which, while hardly recovering the gold as completely as the former, can be used with sulfid ores directly, and which recovers also any silver present. It has been long known that potassium cyanid in dilute solution dissolves gold, especially in the presence of air, with the formation of potassium aurocyanid, $K\,Au\,(CN)_2$, and this reaction is used practically in the process introduced by MacArthur and the Forrests. The action of the cyanid is most rapid in one-fourth per cent. solution, but at the best it is slow, and Sulman and Teed propose to hasten it by the addition of cyanogen bromid. The gold is precipitated either by zinc shavings, or, less commonly, by electro-deposition with iron cathodes and anodes of lead foil. The use of zinc is cheaper, but 1½ to 2 dwts. of gold per ton of liquid remain unprecipitated, and the gold obtained is only about 700 fine. The electrolytic process is more complete and the bullion produced is very fine. At the Worcester mine, in the Transvaal, seventy tons of liquid are treated a day at an expenditure of five horse power, and 12,000 square feet of surface of lead are exposed.

The cyanid process enables low-grade

ores to be worked successfully, and it may be expected that these ores, such as those of the Rand, will be the most important source of gold in the future.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

We record with deep regret the death of Professor Edward D. Cope, professor in the University of Pennsylvania, editor of the *American Naturalist*, President of the American Association for the Advancement of Science, and eminent for contributions to paleontology, zoology and a wide range of natural science. Professor Cope became seriously ill on Tuesday of last week and died on Monday from uræmic poisoning. In his death science has suffered an irreparable loss, and for many the personal loss is equally severe.

The German Zoological Society proposes to hold its seventh annual meeting at Kiel on June 9th–11th, under the presidency of Professor O. Bütschli, of Heidelberg. Reports are expected from Professor Brandt on the fauna of the Baltic Sea, and by Professor Chun on the *Siphonophora*. The report of the editors of *Das Tierreich*, which is published under the auspices of the Society, will also be presented. Lectures and demonstrations are announced by Professor B. Henson on the North Sea Expedition of 1895, by Dr. Apstein on the Methods and Apparatus of Modern Marine Biological Investigations, and by Dr. Vanhöffen on the Marine Fauna of Greenland.

Mr. C. H. Townsend has been appointed Chief of the Division of Fisheries, U. S. Fish Commission, while Dr. H. M. Smith is assigned to the Division of Scientific Inquiry. Mr. Townsend has been connected with the U. S. Fish Commission for fourteen years and has for a long time held the position of Naturalist on the Albatross which he now relinquishes. He is especially familiar with the fisheries of the Pacific Coast, including the many problems connected with the salmon canning industry, which is prosecuted under such varying conditions in the United States and Alaska that no one law can be made applicable to all localities. Mr. Townsend also has a long acquaintance with the fur seal question, and it is to his investigations that we owe most of our knowledge concerning the food, breeding habits and migrations of this animal.

A second circular of the Committee of Arrangements for the International Geological Congress has been issued and the Committee announces a most attractive program. As we have already stated, three excursions are arranged before the Congress: to the Ural region, to Esthonia and to Finland. After the Congress the chief excursion is to the Caucasus, leaving St. Petersburg on the 24th of August in three groups, each under special directors. All the details have been worked out with the greatest care, and expenses are reduced to a very low figure by practically free transportation and by hospitality offered by many of the large cities. The Finland excursion, for example, is estimated at only fifty francs, while the very extensive excursion to the Caucasus is estimated at six hundred and sixty-five francs. The sessions of the Congress take place at St. Petersburg between the 17th and 23d of August, in the rooms of the Imperial Academy of Sciences.

At a meeting in the rooms of the Royal Society in 1893, the Prince of Wales in the chair, it was unanimously resolved "that the eminent services of the late Sir Richard Owen in the advancement of the knowledge of the sciences of anatomy, zoology and paleontology should be commemorated by some suitable memorial." A fund was collected for a bronze statue, which has been executed by Mr. Thomas Brock. This statue has just been placed in the Central Hall of the Natural History Museum, where it stands facing Boehm's statue of Darwin.

The annual meeting of the American Institute of Electrical Engineers will be held in New York on May 18th. The Council have nominated Professor Francis B. Crocker, of Columbia University, for President. The Institute will hold a general meeting at Greenacre, Maine, beginning on July 26th.

The Women's National Science Club met in the lecture room of the National Museum, Washington, on April 7th, 8th and 9th. Many

papers were presented covering a wide range of scientific subjects.

WE regret to record the death of Dr. Edson S. Bastin, professor of materia medica and botany at the Philadelphia College of Pharmacy, from cerebral hemorrhage, at the age of fifty-four years. Professsr Bastin's text-books, 'Elements of Botany' and 'College Botany,' are extensively used, and he was the author of numerous researches in pharmaceutical botany.

THE biological laboratory of Cold Spring Harbor, L. I., conducted under the auspices of the Brooklyn Academy of Arts and Sciences, will again this year be under the direction of Professor H. W. Conn, of Wesleyan University. The laboratory will be open for research work after the middle of June, and the regular courses will begin on July 7th and continue for six weeks.

PROFESSOR JOHN M. MACFARLAND, of the University of Pennsylvania, has arranged an Easter botanical excursion for his students, who will camp in the neighborhood of Savannah, Ga.

MR. E. P. SHELDON, lately instructor in botany at the University of Minnesota, has accepted a commission from the National Herbarium to organize a field party for the exploration of the Blue Mountains in Oregon. He expects to devote at least six months to the field work.

PROFESSOR A. F. VON WALDHEIM, of Warsaw, has been appointed Director of the St. Petersburg Botanical Garden.

THE Scientific Society of Danzig has offered a prize for a research on fungus epidemics in insects which are harmful to the forests. The thesis must be presented before the end of the present year.

THE State subsidy to the fresh-water Biological Laboratory at Plön, under the Directorship of Dr. Otto Zacharias, may be withdrawn next year. Several German societies are, however, urging the Ministry to continue the subsidy, and special subscriptions for the laboratory have been opened.

THE public meeting, which we have already announced, for the purpose of raising a fund for a national memorial to Edward Jenner in celebration of the centenary of his discovery of vaccination was held in the theater of the University of London, on March 31st. The chair was taken by the Duke of Westminster, who made some introductory remarks. Lord Herschell, the Chancellor of the University, proposed the first resolution, which was: "That the present is an appropriate time to inaugurate a work of national utility in honor of Edward Jenner." Lord Lister proposed: "That a subscription be set on foot with a view of promoting, in connection with the British Institute of Preventive Medicine, but in a manner distinguished by Jenner's name, researches on the lines which he initiated." Lord Lister intimated that the name of the Institute of Preventative Medicine might be altered to that of the Jenner Institute.

THE annual dinner of the Chemical Society, London, was held on March 31st, with Mr. A. G. Vernon Harcourt, the retiring President in the chair. Speeches were made by Lord Lister, Sir John Evans, Prof. Michael Foster and others. Professor Dewar is President-elect of the Society.

THE annual dinner of the Institution of Civil Engineers, London, was also held on March 31st. Mr. J. Wolf Barry presided and addresses were made by Sir F. Bedford, Mr. St. John Brodrick, Lord George Hamilton, the Lord Chancellor, and the Speaker of the House of Commons. According to the report in the London *Times*, the president stated that the institution was only about 70 years old, and even the name civil engineer was not very much more than 100 years old. The institution now numbered about 6,000 members, associate members and associates, and about 1,000 students, making in all an industrial army of about 7,000 persons. Their members labored in all parts of the world, and some of them were doing excellent pioneer work in the colonies. By a unanimous vote of the general meeting of the Institution held on the previous day a new departure had been taken. From the present time forward admission to the institution would be gained either by scientific examination or by the submission of some valuable paper or thesis. He thought that would be found of great value to the outside world, since it would be a guarantee that

a member of the institution wherever found possessed that amount of scientific knowledge on which all civil engineering must be based. It would also be of great value to the institution, raising it as a body to its proper position and enabling it to keep pace with those great developments of scientific research which were continually being brought to light.

A BILL before the German House of Representatives appropriates about two and a-half million dollars for rebuilding the hospitals and clinics of the University of Berlin, and about two million dollars for the establishment of the Botanical Gardens with its museum and the pharmaceutical laboratory at Dahlem.

THE interest of the Frohschammer fund of the University of Munich, amounting to $400, is offered for an essay on 'A Psychological Analysis of the Facts of Volition,' which must be presented before October 1st, 1899.

THE Academy of Sciences and Arts of Bordeaux offers a prize of $600 for a paper on the culture of fresh-water fishes.

THE University of St. Petersburg has received a gift of 100,000 roubles from M. Ssimin for a bacteriological observatory.

THE Boston Museum of Fine Arts receives $50,000 through the will of the late Miss Mary G. Morrill.

WE learn from the *Revue Scientifique* that the Geographical Society of Paris has awarded its gold medal to Dr. Nansen; the Ducros-Aubert prize, 14,000 frs. and a gold medal to Lieutenant Hourst for his expedition to the Niger, and gold medals to M. Flamand for his studies in the south of Algeria, to M. Versepuy for his expedition across Africa, to M. Chaffanjon for his journey from the Caucasus to Mandjourie, to commander Koch for his maps of French colonies, and to M. de Flotte for his map of Morocco.

THE library of the late Professor G. vom Rath, the mineralogist, has been presented by his widow to the University at Bonn.

DR. KUNO FISCHER, of Heidelberg, the well-known writer on the history of philosophy, celebrated on the 19th of March the fiftieth anniversary of his doctorate.

PROFESSOR A. BASTIAN has asked for leave of absence for another year from the University of Berlin to continue his anthropological investigations in the East.

ACCORDING to the latest reports there has been a decided decrease in the prevalence of the plague at Bombay, the number of deaths for the last week of which reports are at hand numbering only 360, with 323 new cases. Dr. Yersin reports that flies as well as rats play an important part in the dissemination of the plague.

IN the Bulletin of the American Museum of National History, Dr. J. A. Allen describes a new species of mountain sheep from the British Northwest Territory, which he calls *Ovis stonei*. It is very closely related to *O. dalli*, from which it differs chiefly in the darker coloration and restriction of the white to well defined areas, and, in fact, it would seem entirely probable that *O. stonei* may prove to be merely a subspecies whose darker coloration is correlated with its more southern and less elevated habitat.

THE Committee on Units and Standards of the American Institute of Electrical Engineers has recommended that Hefner-Alteneck Amyl-Acetate Lamps furnished with test certificates from the Physikalisch-Technische Reichsanstalt at Charlottenburg, Berlin, should be temporarily adopted as concrete standards of luminous intensity, or candle power. It ought not to be necessary to go to Germany for a photometric standard. The existence of the Reichsanstalt at Charlottenburg has an undoubted influence on the great increase of exports from Germany. Figures for 1896 are not at hand, but in the course of the preceding five years the annual exports from Germany increased in value by nearly $250,000,000, while in the same period those in England decreased to the extent of $100,000,000.

AT the annual general meeting of the fellows of the Royal Horticultural Society, London, it was reported that in order to celebrate the Queen's long reign the Council had decided to strike a special medal or medallion, to be called the Victoria medal of horticulture, and to be awarded *honoris causa* in the domain of horticulture. The Society has now £4,000 and wishes to increase this amount to £40,000 in

order that it may erect a horticultural hall in London.

ACCORDING to the London *Times* Sir Claude Macdonald has published, in China, a report from Mr. Bourne, of the British Consular Service there, on an extraordinary landslip on the banks of the upper Yang-tsze, which has created a new and dangerous cataract in that river. Mr. Bourne describes the cataract as being situated in latitude 30° 54′ 30″, and in estimated longitude 109° 16′, and about half a mile above a small rapid called Tachang. It is now much the worst rapid in the Yang-tsze, over which junks can only go empty and even so with the greatest danger. The rapid was formed at 10 p. m. on the 30th of September last by a landslip that occurred after 40 days of rain. While the water was high the extent of the obstruction was not apparent; as the river sank the rapid became impassable to upward-bound junks, and remained so for about a month. On the 4th of December the first upward-bound junk was hauled over, and there seems a great probability that as the river drops further the rapid will become again impracticable to the upward traffic. A block of ground, measuring 700 yards north and south by 400 yards east and west, has fallen down from the slope of the mountain on the north bank, a distance of 150 yards, reducing the breadth of the river from 250 to 80 yards.

IN France the manufacture of matches is a state monopoly and under state control, and in view of the numerous cases of illness among the workers and the many complaints which have been made in the press the Minister in charge has asked the Academy of Medicine to draw up rules for the regulation of the government factories. According to the *Lancet*, the Academy has agreed to the following answer being sent to the Minister: 1. It is necessary to put a stop to the unhealthy conditions which exist in many of the match factories in France. 2. The suppression of the use of white phosphorus is the only certain way of insuring health to the workers in this manufacture. 3. The employment of perfected automatic machinery is a costly matter and carries with it the condition that all dangerous operations should be done under glass. 4. Until these recommendations can be carried out as a whole the present unhealthiness can be diminished by thorough ventilation, short shifts for those men working in the dangerous shops, careful selection of healthy hands, and periodical medical inspection, with power to prohibit the labor, either for a time or altogether, of anyone with lesions of the mouth or whose general health is impaired.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Medical College of the New York University and the Bellevue Hospital Medical College have been consolidated under the control of the New York University. The enrollment of students last year in the two schools was 1,057.

THE Sheffield Scientific School of Yale University receives $25,000 by the will of Mrs. Sarah Van Nostrand.

THE department of natural history of Vassar College will receive about $25,000 through the settlement of the will of the late Jacob P. Giraud.

A BILL before the Texas Senate appropriates for the State University $35,000 for 1897 and $85,000 for 1898, and in addition $42,000 annually for the medical department.

THE trustees of the Teachers' College have appointed Mr. George P. Krapp associate professor of the biological sciences, in conjunction with Professor F. E. Lloyd.

DR. BECKENKAMP, teacher in the Chemical School at Mühlhausen, has been called to the chair of mineralogy at Würzburg; Professor L. Claisen, of Aix, to the chair of chemistry at Kiel. Dr. Gaupp has been promoted to an assistant professorship of anatomy at the University of Freiburg. Dr. Boldinger has qualified as docent in analytical chemistry in the University of Amsterdam, and Dr. v. Buchka as docent in chemistry in the Polytechnic Institute at Charlottenburg.

PROF. v. KRIES, of Freiburg, has declined a call to the chair at Berlin vacant through the death of Du Bois-Reymond.

IT is proposed to take powers to transfer the

patronage of Edinburgh Royal Botanical Gardens to the Crown, and to unite the Regius professorship and the University professorship of botany.

DISCUSSION AND CORRESPONDENCE.

THE BRUCE ASTRONOMICAL MEDAL.

To the Editor of Science: Miss Catherine Wolfe Bruce, of New York city, to whom astronomy all over the world is indebted for liberal and intelligent benefactions, proposes to found a gold medal to be awarded not oftener than annually by the Astronomical Society of the Pacific for distinguished services to astronomy. The medal is to be international in character and may be given to citizens of any country and to persons of either sex. The design for the obverse of the medal is the seal of the Astronomical Society of the Pacific. The medal is to be 60 mm. in diameter. The reverse is to bear this inscription: "This medal founded A. D. MDCCCXCVII. by Catherine Wolfe Bruce is presented to—(name)—for distinguished services to Astronomy——(date)."

The Astronomical Society regularly awards also a bronze medal founded in 1890, by the late Joseph A. Donohoe, for the discovery of each unexpected comet.

Edward S. Holden.

Lick Observatory.

PROFESSOR SCOTT'S BIRD PICTURES.

In *Scribner's*, for April, Professor W. E. D. Scott 'scores the conventional method of bird-stuffing, and furnishes eight pictures of birds which are stuffed according to his own ideas.' Now, Professor Scott speaks from long experience, and what he says is largely, but by no means wholly, to the point, for much of our museum work *is* undoubtedly bad. Whether or not the pictures which illustrate the article and are held up as examples for us to follow are any great improvement over our more recent bird work is very questionable. It might seem ungracious to criticise these pictures of stuffed birds, but when our attention is called to them by aggressive italics and special postal cards criticism would seem to be invited. It therefore becomes a painful duty to say that the Clapper Rail and Robin are certainly not in conventional attitudes and that aside from these at least three of the birds are decidedly faulty, these, moreover, being birds with which Professor Scott should be most familiar. The Bittern, p. 503, is so poised that he seems about to topple over backward, while his neck and free foot are both wrong. Ward's Heron, p. 501, and the Little Blue Heron, p. 502, both have curves in their necks which, from the structure of their backbones are *physically impossible*. The shape and articulation of the neck vertebræ of herons is such that they *always* have more or less of an angular bend in their necks, whether these be extended vertically or doubled upon themselves, and failure to reproduce this very characteristic feature means failure to convey a correct idea of a heron. We may accept Professor Scott's strictures, but we decline to follow his models.

F. A. Lucas.

NOTE ON A SIMPLE METHOD FOR NEWTON'S TOTAL REFLECTION EXPERIMENT.

Demonstrators who have written for their fellows seem to have overlooked the fact that Newton's beautiful experiment, showing that for any pair of media each color having its own index of refraction has, therefore, its own critical angle, may be exhibited by much more simple and inexpensive means than the four prisms usually required for that purpose.

All that is really necessary beside the lantern or other means for getting a strong sharp parallel beam is a refraction tank, such as Wright's, having glass ends. If this tank is set up in the path of the beam in such a manner that the light may be made to pass obliquely upward into the water as for total reflection it will be found that, by adjusting the depth of the water in the tank and the angle of incidence of the beam, the apparatus can be so arranged that only red rays will emerge, all others being totally reflected. Now, by diminishing the angle of incidence of the pencil on the air surface, tilting the mirror if one is used, the remainder of the spectrum may be brought in order out of the water, and, by reversing the operation, sent back again totally reflected. Just as in the demonstration in which the right-angled prisms are employed, the image of the

slit formed by that portion of the pencil which at every incident angle undergoes reflection is tinted by the rays so sent back.

As in all such work, the sharper the beam the better the results, but I find the experiment succeeds very well indeed with the beam obtained by projecting with the ordinary optical front a narrow slit in the stage of my electric lantern.

F. W. MCNAIR.

MICHIGAN MINING SCHOOL.

SCIENTIFIC LITERATURE.

Annual Report of the Geological Survey of Canada for the Calendar Year 1894. G. M. DAWSON, C. M. G., LL. D., F. R. S., Director.

This volume is No. 7 of the New Series of Reports of the Canadian Survey, and comprises 1,206 pages, accompanied by eleven maps, fifteen plates and diagrams, besides figures in the text. It is a storehouse of facts relating to the geology of all parts of the Dominion, and is the first of the reports prepared by the guiding hand of the new Director.

The staff of this organization, including all employees, professional and ordinary, numbers fifty-one persons, and the total amount, expended sum up $110,000 for the fiscal year ending June 30, 1894. The several reports are, first a summary of all the operations by the Director; then an account of the geology of the Kamloops map-sheet in British Columbia, by Dr. Dawson; an exploration of the Finlay and American rivers in the north part of the same province, by R. S. McConnell; preliminary report upon the south part of the district of Keewatin, by D. B. Dowling; the geology of the southwest sheet of the eastern townships, by R. W. Ells and F. D. Adams; the surface geology of eastern New Bruswick, northwestern Nova Scotia and a portion of Prince Edwards Island, by R. Chalmers; upon the chemistry and mineralogy, by G. C. Hoffmann; upon mineral statistics and mines for 1893 and 1894, by E. D. Ingall and H. P. H. Brumell, and many paleontological notes interspersed here and there by J. F. Whiteaves and H. M. Ami.

Out of such a mass of information one can only refer to matters in which he is most interested.

At Athabasca landing, near the Canadian Pacific Railway, a trial boring has been effected to the depth of over 1,000 feet for petroleum. Beds of soft Cretaceous sandstones from 140 to 225 feet in thickness, for a distance of ninety miles along Athabasca river, are more or less saturated with bitumen. It is believed that the petroleum occurs in Devonian strata, which in the neighborhood underlie the Cretaceous. As the tar sands proved to be somewhat thicker than was expected, and various difficulties arose, partly in connection with the large supplies of gas exhaled, operations had not been completed at the time the report was made; and it was thought it would be necessary to continue this boring five hundred feet further before abandoning the location. The probabilities seemed ample for expecting the development of another oil field in this district.

The statistics of production of valuable minerals give a total value of $20,950,000 for the year 1894, which is a slight falling off from the yield of the previous year. The more valuable products in the order of their importance are coal, nickel, bricks, building stone and gold, the last having the value of $1,042,055. British Columbia produced the most, $456,066, followed closely by Nova Scotia. The Columbian mines are almost entirely worked in placers of Pliocene age, derived from auriferous veins in the Carboniferous and Triassic rocks. Dr. Dawson states that "British Columbia has now fairly entered on a period of rapid and thorough development of its mineral resources."

Perhaps with the idea of promoting this development, large space is given to the description of the geology of the Kamloops sheet, with a map descriptive of an area about eighty miles square, just above the latitude of 50° and comprised between longitudes 120° and 122°, through which the Canadian Pacific Railway takes its course. The aggregate thickness of the formations in this field is 79,500 feet. The Archean is wanting, though present just to the east of longitude 120°. The Cambrian consists of two parts: the lower, or *Nisconlith* series—dark argillites; and the upper, or *Adam's Lake* series—volcanic beds with arkose conglomerates; both amounting to 11,500 feet. The Silurian and Devonian have not

been recognized. The Carboniferous or *Cache Creek* series is 12,000 feet thick, one-third limestone. Its character is like that of the corresponding limestones and quartzites of corresponding age observed in our Fortieth Parallel Survey. The Triassic, or *Nicola* group, occupies a considerable area, with a thickness of 10,000 to 15,000 feet comparable with the rocks of the same age in Nevada. The materials are largely volcanic, diabase porphyrites becoming amygdaloidal; also agglomerates passing into diabase tuffs. The sediments are marine limestones and argillites. Certain limited areas are believed to be Lower Jurassic, though not separated upon the map.

Passing the Cretaceous development, the Oligocene Tertiary, or *Coldwater* group, is quite important, its materials consisting of aqueous deposits, conglomerates, sandstones and shales, in some places holding coal and lignite. None of the beds are marine, and all are said to be separated from the Miocene by unconformity.

Fully half the area of the map is occupied by the Miocene, which is composed of volcanic rocks over 9,000 feet in thickness. The lower division consists mainly of augite-porphyrites; the middle of fine-grained tuffs that have been laid down in water containing beds of lignite, perhaps of merchantable value, and the upper of basalts, melaphyres, etc., easily seen to have been ejected from numerous local vents. Fossil plants have been collected from all parts of the Cretaceous and Tertiary series, and serve for the basis of the stratigraphical reference and assignment.

The granites found in the Kamloops area are of medium coarseness passing from biotite-granite to hornblende-biotite granite, are sometimes foliated, especially near their contact with Paleozoic strata, and are probably post-Archean in age.

Perhaps the most interesting part of the volume is the description of the geology of the Montreal sheet by Dr. Ellis. This area lies between latitudes 45° and 46°, immediately north of the international boundary and between longitudes 72° and 74°. It is the first area studied carefully by the Survey, as it embraced the vicinity of Montreal, the chief city of the Dominion; and it is interesting to United States geologists because the formations pass from it into our territory. It has also great historic interest, as it has been the field of vigorous controversy.

Before 1860 it was supposed that its structure furnished the key to the solution of the metamorphic problem of eastern America. Studies by Sir William E. Logan furnished the foundation for a peculiar paleontology, which referred the terranes southeast from the St. Lawrence to the horizon of the Chazy-Calciferous; some of these had, in the previous decade, been referred to the Medina or Middle Silurian. Because of the accurate stratigraphical and paleontological studies of this area, it was claimed that the extension of the terranes southerly defined the age of the crystallines of New England, all of them being Silurian or Devonian. The Vermont Geological Survey had accepted these Canadian conclusions, fortified, as they were, by the opinions of Professor James Hall. But the Vermonters could not accept Logan's intepretation of the structure of the Green Mountains as they continued into Canada. Logan called it the 'Danville and Sutton Synclinal;' whereas on the southern side of the boundary line no interpretation of the dips could justify any such structure. In the midst of these perplexities of adjustment there came, at the end of the year 1860, a communication from Sir W. E. Logan containing a letter from Barrande affirming the primordial (Potsdam) age of the trilobites referred by Hall to the Hudson River group, and the consequent abandonment of a belief in the Silurian age of the Olenellus slates. Much readjustment of the details has been required, and it is only now, thirty-five years after the publication of Barrande's letter, that the details are properly presented. Instead of the 'Danville and Sutton synclinal' Dr. Ellis gives us the 'Sutton mountain anticline,' and there are broad expanses of pre-Cambrian and Cambrian terranes to take the place of the former Middle and lower Silurian. This pre-Cambrian Green Mountain area is about twenty miles wide at the international boundary, flanked on both sides by a Cambrian terrane and there by the Cambro-Silurian. On the west side the Calciferous sandrock seems to be absent be-

tween the Cambrian and the Chazy-Trenton limestones of Farnham. On the east side the Cambro-Silurian succession involves the reference to a lower horizon than has been commonly accepted, of the micaceous limestones which pass into the group termed the 'Calciferous mica schist' in the Vermont and New Hampshire reports. This reference is based upon discoveries of graptolites about Lake Memphremagog clearly of the age of the lower Trenton.

In the St. Lawrence plain country there are very few strata referred to the upper Silurian; but on the Memphremagog side well-defined Niagara and Devonian fossils are abundant.

This area has also afforded much material for petrographical studies in the series of bosses and eruptive masses of diorites, diabase, syenites and late granites extending from Stanstead across the whole sheet to the Laurentian gneisses and anorthosites of the northwest corner back of Montreal, a part of the original Laurentian area of Logan. The anorthosites are now clearly understood to have had an eruptive origin; and hence the original conception of an upper Laurentian or Labrador system of stratified rocks is abandoned.

The Dominion of Canada now furnishes us the most important field for the study of glacial phenomena. By slow degrees the existence of an outer margin and various terminal or recessional moraines has been proved for the United States; and it remains needful to explore the districts farther north up to the Arctic regions in order to find additional moraines and the starting points of the ice movements. Dr. G. M. Dawson, the Director of the Survey, has given names to two parts of what has been called the continental ice mass. One is the *Laurentian* and the other the *Cordilleran* glacial sheet, each with an independent existence, but sending out ice streams which have coalesced in the great western plains. The Cordilleran mass was somewhat the smaller of the two, having at its maximum development a length of 1,200 miles. The main gathering ground or *névé* of this ice sheet lay between Latitudes 55° and 59°; and the ice flowed northerly, into Alaska 850 miles, westerly into the Pacific Ocean, southerly as much as 600 miles, into the edge of the United States, and southeasterly over peaks rising to altitudes of over 7,000 feet; thus implying a thickness of over 6,000 feet above the principal depressions of the surface. Dr. Dawson thinks there were two maximum periods of glaciations in the Cordilleras, followed by subsidences, in the first case 500 and in the second to 2,500 feet below the level of to-day. There are numerous terraces of boulder clay and white silts corresponding to these levels. Indeed, judging from the descriptions and views of these high terraces, there is nothing comparable with them anywhere else upon the continent.

From the report of Mr. Low it would appear that the central part of the Labrador peninsula was the gathering ground of the Laurentian ice sheet, from which glaciers flowed off in all directions, notably to the west, east and south. The striæ indicating the westerly movement are the least distinct.

Mr. Robert Chalmers reported upon the surface geology of the maritime provinces. He finds evidence of ice movements northerly and easterly from the higher elevations in northern New England and Quebec, as well as southerly in the St. Johns valley. No ice reached the peninsula of Nova Scotia from the mainland except to a very slight degree; and the glaciation effected is explained by supposing radial movements from the Cobequids and the watershed of the main peninsula. The general conclusion drawn is that there was no movement from the St. Lawrence valley up and over the New England highlands towards the sea. All the phenomena are to be explained upon the theory of local glaciers moving outwardly to all quarters of the compass from the greater mountains. Instead of our going to Canada for the source of the New England glaciation, the Canadians now come to the White and Green mountains in search of the ice which brought débris into the St. Lawrence valley. The writer would remark that these conclusions are undoubtedly correct for one of the later epochs of glaciation. The glaciers of the Champlain age entering the St. Lawrence valley, both from the Labrador peninsula and the New England summits, brought icebergs which floated over Montreal and Quebec and induced the severe climate, lasting for a long time, which was suitable for the habita-

tion of the boreal mollusca. For this reason the till of the lower St. Lawrence valley seems to have been deposited under marine conditions, covering up all the marks made by the earlier ice sheets. Hence it is not strange that the Canadian geologists have so generally given the largest place to icebergs in their conceptions of the work done in the ice age.

The perusal of this volume clearly shows the great efficiency of the Director and his assistants in carrying on the work so ably commenced by Logan and Selwyn. The field work has been carried on economically and successfully. While theories of divers kinds are advocated, there seems to be no attempt to distort the facts to square with preconceived notions, and all will hope that abundant means will be continuously supplied to the survey organization to carry on its explorations in a manner honorable to the Dominion government.

C. H. Hitchcock.

Tables for the Determination of Minerals by Physical Properties ascertainable with the aid of a few field Instruments based on the system of Prof. Dr. Albin Weisbach. By Persifor Frazer. Lippincott. 1897. 4th edition enlarged, 163 pp.

The first edition of this book appeared in 1874 and has been followed by the succeeding editions at varying intervals (1877, 1891, 1896).

This is really an authorized translation of the German work of Weisbach, to which Professor Frazer added the empirical formulæ best representing the data at hand. Few changes were made till the publication of the third edition which appeared rewritten and considerably changed in detail, though following the lines laid down in the first edition. The chemical formulæ previously used were replaced by those given by Groth in his 'Tabellarische Uebersicht der Mineralien,' and to the tables were added the characteristic habit, structure, fracture, specific gravity and association of the minerals.

The present edition is an enlarged and corrected reprint of the preceding. To the seven hundred and sixty odd species and subspecies previously included, there have been added a hundred and thirty-five others, which embrace several old and well known species, like microcline, and many minerals which recently have been described or rendered of economic importance, like monazite.

As in the earlier editions, the only instruments necessary are a knife, streak table, file and pocket lens. The classification is based on the lustre, streak and hardness, thus dividing the minerals into sixteen different classes upon criteria which are easily determined by the practical manipulator. The book is intended to be of service to the student, as an artificial aid to memory; to the field geologist, as a reminder and handy book of reference for properties of unusual minerals; and to the amateur, as an incentive to more accurate observations.

The author, for the sake of economy, in using the old electrotype plates, has, in a measure, decreased the value of the book, as their use has caused the retention of features which to-day savor of an earlier period in mineralogy. At the present time there is a tendency to discard even the well known crystallographic symbols of Naumann in favor of the Miller system. The present book, however, retains the abbreviated Naumann symbols suggested by the elder Dana, without incorporating the modifications introduced in the last edition of E. S. Dana's Manual of Mineralogy. A still more pronounced archaism is the introduction of such 'mineral species' as *pitchstone* and *perlite* which belong to rocks and not to minerals. Similar critiçism might be passed on the ambiguous use of the term 'andesite,' which on page 92 is used to designate a mineral, while on page 99 it designates a rock; or the term *pegmatite*, which is given as a varietal name for orthoclase.

Turning to the tables themselves, there seems to be looseness in the choice of values given for hardness and specific gravity; the habitat or association of the minerals, and the symbols used as abbreviations.

In turning over the pages, the eye catches such deviations from the hardness, as on page 90, where the opal is ranked as '5' (Dana 5.5.–6.5), or the separation of 'andesite' on page 92 from laboradorite on page 100 (both 5–6). The choice of values for density may be illustrated by those given in the mica group, where the higher limits seem to be preferred,

though micas generally give lower values than the true on account of their crystal habit. For example, Lepidolite 2.9 (2.8–2.9), biotite 2.9 (2.7–3.1), muscovite 3. (2. 76–3.), phlogopite 2.9 (2.78–2.85).

In spite of these slight deviations, which undermine one's faith in the accuracy of the book, there is little doubt that the tables will prove serviceable to the practical worker who wishes to gain at a glance the approximate values of the substance under investigation.

The typography of the book is good, the type is clear, and the matter is well spaced. An especially attractive feature is the size, which is adapted to the collecting bag or pocket. The few instruments required, the use of the external and physical properties only, the notes on the paragenesis, and the great number of rarer minerals, will make it serviceable alike to the field geologist, the mining engineer and the teacher.

E. B. MATHEWS.

Traité élémentaire de mécanique chimique, fondée sur la thermodynamique. P. DUHEM. Paris, A. Hermann. 1897. Vol. I. Large octavo. Pp. viii+299. Price, 10 francs.

The object of this book is to give a consistent, coherent account of the mathematical theory of the changes in physical state and chemical constitution, as obtained by an application of thermodynamics. This would be valuable even if badly done, since the mathematical treatment of physical chemistry in book form is painfully deficient in comparison with the exhaustive handling of the experimental side of the subject by Ostwald. This particular book is doubly valuable because it not only gives us the mathematical development of the subject, but presents it in a masterly way.

Duhem begins with a short sketch of the analytical methods to be used, and then develops the fundamental principles of thermodynamics, taking up in order the conservation of energy, the first law of thermochemistry, the theorem of Carnot-Clausius and the absolute temperature, the entropy and the thermodynamic potential, the general equations of thermodynamics, the application of the thermodynamic potential to systems at constant pressure or constant volume, perfect gases, isothermal displacement of equilibrium, heat effects, adiabatic displacement of equilibrium and the change of the equilibrium with the temperature. The remarks on the accuracy of Hess's law, page 49, are especially worth reading because the points raised are usually overlooked in the statement of the theorem.

The second part of the volume—devoted to false equilibria and explosions—is even more interesting than the first part because the point of view is less familiar. Duhem has been troubled like many others by the fact that in certain cases there was a state of equilibrium when the theory, as formulated, said that this was impossible. Gibbs showed that many of the difficulties could be removed by the assumption that the surface of a phase was in a different state from the interior—in other words, by the theory of capillarity. Duhem attempts to carry this farther by introducing the notion of viscosity or of false equilibrium. His idea can best be understood by an analogy from mechanics. Suppose we have a body on an inclined plane. In an ideal state of things where there is no friction the body is not in equilibrium and will slide down the inclined plane. In the world as it is we can not get rid of friction entirely and the body will remain stationary on the plane, provided the pitch is not too great. Similarly, if there were no passive resistance to change, water vapor and a mixture of hydrogen and oxygen in the proportions in which they combine to form water should yield the same system under the same conditions. At low temperatures this is not the case experimentally, so far as we now know; so that it is natural to follow out the analogy and to say that in the actual chemical world there is a chemical friction or chemical viscosity and that states of equilibrium are thus possible which could not occur in a system where there were no passive resistances to change.

Duhem now attributes to capillary phenomena the behavior of supercooled vapors and superheated liquids, and he is inclined to group under this head supercooled solutions, supersaturated solutions and some theoretically unstable solid allotropic forms, classifying under false equilibria hydrogen and oxygen, liquid

phosphorus, silicon trichlorid and many other substances. It is a question whether this is justifiable. It seems irrational to put rhombic and monoclinic sulphur in one class and the two modifications of phosphorus in another; but it is certainly interesting, and the application of his theory to the point of reaction, to reaction velocities and to explosions deserves careful attention. It will interest many to note that Duhem's view of a mixture of hydrogen and oxygen as being actually in equilibrium at low temperatures is not reconcilable with the Ostwald-Nernst idea that it is not a case of equilibrium at all, but rather of immeasurably low reaction velocity. A fairly strong argument can be made out for either view, and the scientific world owes thanks to Duhem for making the question a live one.

WILDER D. BANCROFT.

Trigonometry for Beginners. REV. J. B. LOCK, M. A. Revised and enlarged by JOHN A. MILLER, A. M., Indiana University. New York, The Macmillan Company. 1896. 200 pp. Price, $1.10.

Trigonometry, of all elementary branches of mathematics, might easily substantiate its right to be considered the most congenial and popular subject that necessarily claims the attention of engineers and practical men, otherwise but little inclined to sympathize with the purest in the science. Led on by its numerous and interesting applications, many a student, without being aware of it, has taken his first step in the theory of functions, acknowledged the results to be fascinating as well as eminently practical, and gone his way to rail at the higher theory, quite unconscious of the spectacle he thereby makes of himself. The natural result of this favoritism has been a steady improvement in the quality of the text-books produced in trigonometry until such works as that of Chauvenet and, to mention a less ambitious book, that of Wells, challenge competition successfully for a series of years.

With a new edition of Lock's Trigonometry, The Macmillan Company enters the field, and with its usual business sagacity have secured its revision by an American. Professor Miller has certainly earned the right to have his name on the cover, indeed, because of additions and improvements far less necessary and fundamental many a man would have called the volume his own. As claimed, the new edition corrects the fundamental weakness of its predecessor by carefully emphasizing the necessity for proofs for all relations, especially for the addition formula, that are rigidly correct for all values of the angles involved. To this end, as is necessary, we find clear demonstrations of such relations as, for example, $\sin(90° + A) = \cos A$ for all values of A. This enables the author in § 79, while attempting to generalize the addition formula, to write.

$$\sin[90° + (A' + B)] = \cos(A' + B), \quad 0 < A' < 90°, \; 0 < B < 90°.$$

He then remarks since A' and B are now both less than 90° we may write

$$\cos(A' + B) = \cos A' \cos B - \sin A' \sin B. \quad (\S\ 76).$$

There is certainly a flaw in the general accuracy of the argument up to this, the pivotal point of trigonometric analysis, for § 76 does not completely justify this expansion, since the demonstration to which reference is made depends upon a figure representing both A' and B, as in the first quadrant, and their sum also as in the first quadrant, whereas, in the case before us, we have no means of knowing whether $A' + B$ is greater or less than ninety degrees. In fact, before analytic demonstrations for particular cases can be accurately defended, geometric demonstrations must be given for $0° < A < 90°$, $0° < B < 90°$ for the four possible cases under this head, namely,

$$(A + B) < 90°, \quad (A + B) > 90°, \quad (A - B) > 0°, \quad (A - B) < 0°.$$

On the other hand, it must be admitted that the author, in paragraph seventy-eight, calls attention to the fact that a similar construction will apply to all possible cases, and even gives a third example, different from either, of those that are necessary. The criticism is, however, that, since up to this point unusual effort has been made to demonstrate the addition theorems, this is certainly not a good place to leave necessary steps to the student.

Like most English text-books, the present

volume is very rich in illustrative examples carefully and admirably adapted to meet the requirements of both teacher and student. Indeed, this feature of the book will be its strongest recomendation to many practical teachers. In revising the work Professor Miller has placed Chapter VII., which, in the old edition, followed Chapters VIII. and IX. in its logical position, and by thus developing first the Cartesian system of coordinates has succeeded in making the results of the later chapters general. To this portion of the text other tables might be added to some advantage, for example, one tabulating the values of functions of angles that are multiples of five, and one giving an expression for each function in terms of the others. While of undoubted worth as a means of reference, such tables, it might be argued, are of doubtful value from a pedagogic standpoint. At least they should be required to be established by every student of trigonometry, and it would have been well to have required them among the examples. The book is also unique in respect to the absence of the time-honored figures illustrating the positions and comparative lengths of the functions other than the sine and cosine in the different quadrants of a circle whose radius has been assumed as the unit. Here, again, the omission may be defended on the ground that nine students out of ten, having these figures for the special case in mind, will carry to the grave the impression that the functions are lines instead of ratios. Nevertheless, they are of value in mechanical drawing, and especially as affording a ready means of prompting the memory in the thousand and one simple relations they illustrate, and by constant emphasizing of the ratio definitions on the part of the teacher they can be used without confusion of ideas.

The added chapter on inverse functions, and the one that has been much improved on the solution of trigonometric equations, are valuable and essential parts of the new edition, the importance of which will not be underestimated by the advanced student of mathematics. Finally the analytic portion of the plane trigonometry is completed by the establishment of the so-called tangent formula, $a - b : a + b = \tan \frac{1}{2}(A - B) : \tan \frac{1}{2} A + B)$, by a direct development from the rigidly demonstrated addition theorems. Many of the old treatises prove this formula, probably because of its importance, geometrically, and lose thereby in generality. The geometric proof is of exceeding interest, however, and the present demonstration would be emphasized and the book gain in pedagogic strength were it given in a foot-note with a corresponding valuable reference to its limitations.

In outline the design of the book is to discuss, in the first thirteen chapters, the general theory of the trigonometric functions; then, in chapter fourteen, to give a short review of the theory of logarithms followed by a discussion of the solution of the triangle, and, finally, by two short chapters giving applications to engineering and geometrical problems. This is the time honored arrangement, certainly in the hands of a good teacher sufficiently effective. As our author says, "the discussion of logarithms belongs properly to algebra," and as a rule the student has met with them during the preceding term's work, but has, nevertheless, far from mastered their application and still less their theory. Why not then begin at once with a review of the theory of logarithms and insure a thorough mastery of their application by constant practice from the beginning? While the student is learning about angular measurement and the trigonometric ratios the class can be exercised in the evolution of complicated numerical expressions and in the solution of logarithmic equations, and, as soon as the functions are developed, a large number of the applications to right triangles reserved for the last chapters may be discussed immediately, affording new material for logarithmic work, thus arousing at the start the keen interest of the practical mind.

The last thought has been acted upon by the author. Pages 10, 11, 26 and 27 are filled with practical problems of a most interesting character, all of which, however, are intended for solution without the aid of logarithms. Finally Professor Miller has added two short chapters, in which he develops the theory of the solution of spherical triangles. Here, as in the plane trigonometry, the author is fully alive to the limitations of geometric proof and care-

fully renders the fundamental formula $\cos a = \cos b \cos c + \sin b \sin c \cos A$ perfectly general, and then by basing all further deductions on this one determines rigorously all necessary relations.

To some teachers it may seem that on this feature of the work too much emphasis is laid, and that too much time, and, possibly, clearness and definiteness are sacrificed to this end. On the other hand, the careful student will maintain that this one feature should recommend the book most highly, for long after the pupil has forgotten what a cosine is he will have retained the habit of mind which distinguishes clearly between the general and the particular, and will be less apt to make that most frequent of all mistakes in logic, that of arguing to the former having proved the latter. Certainly, if the present criticism is at all just, enough has been said to put in evidence the fact that Professor Miller has succeeded, at important points, in improving Lock's trigonometry, and his work will assuredly be found acceptable to many educators.

So far as the publishers are concerned, the typographic results are excellent; different types have been employed with useful discrimination, and a cheerful appearance is given through liberal use of space. The book, however, is, for practical use, large. It contains two hundred pages, is heavier than Chauvenet, while containing only one-fourth as much subject-matter, and three times as heavy as Wells, while, save for some sixty pages devoted to logarithmic tables of questionable value, it does not contain any more. The student of Lock's text book in its present dress will certainly receive the impression that trigonometry is a very large subject indeed, and the probabilities are that he will never entirely recover from this, his first impression.

J. B. Chittenden.
Columbia University.

SCIENTIFIC JOURNALS.

THE ASTROPHYSICAL JOURNAL, MARCH.

Résumé of Solar Observations Made at the Royal Observatory of the Roman College During the Second Half of 1896: By P. Tacchini. A general summary of solar observations, giving the distribution in latitude of spots, faculæ and prominences during the period indicated.

Oxygen in the Sun: By Arthur Schuster. In a short note Professor Schuster calls attention to the close agreement in wave-length between two of the triplets of the 'compound line spectrum' of the oxygen and two of Young's chromosphere lines. In view of the recent opening of the question of the existence of oxygen in the solar atmosphere, Professor Schuster suggests that an accurate determination of the chromorpheric lines in question be made.

The Yerkes Observatory of the University of Chicago—I. Selection of the Site: By George E. Hale. The writer gives a review of the considerations that led to the selection of the site of the Yerkes Observatory. A general discussion of the points to be considered in the selection of an observatory site is followed by a discussion of the conditions to be met in the case in hand.

Preliminary Table of Solar Spectrum Wavelengths: By Henry A. Rowland.

On the Occurrence of Vanadium in Scandinavian Rutile: By B. Hasselberg. The paper describes the detection of the heretofore unsuspected existence of Vanadium in Norwegian and Swedish Rutile. The research was entirely spectroscopic.

A New Formula for the Wave-lengths of Spectral Lines: By J. J. Balmer. The author discusses a generalization of his formula for the hydrogen spectrum. This formula, which is generally known under the name of 'Balmer's law,' is $\lambda_n = 3645.6 \frac{n^2}{n^2-4}$. By introducing a new constant c, we have $\lambda_n = a \frac{(n+c)^2}{(n+c)^2-b}$, which is found to satisfy the series of lines hitherto investigated by Kayser and Runge by the aid of the formula $\frac{1}{\lambda_n} = A - \frac{B}{n^2} - \frac{C}{n^4}$. Balmer's new law is similar to that due to Rydberg, except that the latter considered the value of $\frac{b}{a}$ to be constant for all elements. Several geometrical constructions based upon the formulæ are given.

Minor Contributions and Notes, Reviews of Recent Astrophysical Literature.

Bibliography of Recent Astrophysical Literature.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—273D MEETING, SATURDAY, MARCH 13.

A PAPER by R. T. Hill and T. W. Vaughn on 'The Lower Cretaceous Gryphæas of the Texas Region' was presented by Mr. Vaughn. He spoke of the abundance of the individuals of this genus and their value in determining the location of artesian wells, the various species being characteristic of certain strata. He traced the phylogeny of the species and dwelt at some length on their involved synonymy.

Chas. F. Dawson spoke of the 'Dissemination of Infectious Diseases by Insects,' instancing the manner in which tuberculosis, swine plague, Texas fever and anthrax could be thus spread. The speaker described his own experience with flies, stating that from their habits they were particularly liable to convey disease.

Under the title, 'The Type (?) of a New-Old Species,' William Palmer spoke of the confusion which existed in regard to certain genus of birds, stating that while Linnæus had originally given a specific name to what he believed to be a cosmopolitan species, he had subsequently admitted a second species, based on a plate, while another author had described a third from still another plate. There was no type existing of any of these, while the authors of the second and third species had no specimens when they established their names. Mr. Palmer stated that two distinct birds had been confused under the three names, and that he proposed to separate them, basing his description on a bird which he had selected among numerous specimens. Would this specimen, to which a binomial name and definite description were attached for the first time, be a type?

Sylvester D. Judd, in a paper entitled 'Sexual Dimorphism in Crustacea,' limited himself to the *Amphipoda*. He stated that while in certain genera the males and females were very similar, there were other genera where secondary sexual characters were so marked that different sexes of the same species might be thought by the casual observer to belong to different genera. The anterior and posterior parts of *Amphipoda* are the parts that present secondary sexual characters. The antennæ are particularly subject to variation; in some species the inferior antenna is several times as long in the male as it is in the female. In other species the caudal end of the body of the male is monstrously developed. The hairs that occur on the anterior and posterior parts of the body are differently disposed, thus only in the males of *Byblis* do the antennal hairs form brushlike tufts, and in a number of other genera the hairs on the antennæ of the males are modified into elaborate sense organs called calceoli. It appears that the parts of the body of *Amphipoda* which exhibit secondary sexual characters often coincide with those parts upon which specific differentiæ are founded.

F. A. LUCAS,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, MEETING MARCH 4.

I. *Cleavage of the Egg of Arenicola.* The cleavage belongs to the type known as 'spiral,' or better oblique. There is considerable yolk in the egg and it is almost evenly distributed before segmentation. In the four-cell stage there are three smaller cells and one very large one representing nearly half the entire egg. All the cells contain yolk. The two 'cross-furrows' on the upper and lower poles of the egg are parallel and are formed by the blastomeres B and D; the cross-furrow at the lower pole is much longer than the other, however, and is perfectly constant up to a stage shortly before the closure of the blastopore, thus affording an invaluable means of orientation. The future median plane passes at right angles to this furrow and thus forms an angle of 45° with each of the first two cleavage planes. The upper pole forms the anterior end and the lower pole the posterior end of the worm.

Ectoblasts, mesoblasts and entoblasts are formed in the usual way. The cells X and M (vid. Wilson, Nereis) are by far the largest cells in the egg. Primary trochoblasts, sixteen in number, arise from first quartet and are supplemented later by three cells from each of the small micromeres of the second quartet, which complete the prototroch except dorsally, where a break is left. Through this space four cells, derivatives of the first quartet, pass and come to lie posteriorly to the pototroch. The

first bilaterally symmetrical division in the egg (58-cell stage) is the fourth division of the blastomeres of the first quartet, viz., the formation of the apical cross of eight cells. There are no head-kidneys, and the cell corresponding to the nephroblast remains on the surface as a small, inconspicuous ectodermal cell.

The ventral or somatic plate grows as in *Amphitrite*. The second bilaterally symmetrical division in the egg is the third division of the large posterior cell (X). A smaller cell is given off anteriorly and lies across the median plane. The somatic plate broadens laterally and posteriorly, the lateral portions growing posteriorly faster than does the central portion, so that finally the cells along the posterior edge begin to meet in the median line just dorsal to the blastopore. The point where this concrescence begins is the point where the paratroch appears. This organ is formed from derivatives of X, but by an entirely different set of divisions from those which take place in *Amphitrite*, according to Dr. Mead's very kind personal communication. Within the paratroch are enclosed certain small cells which later become the proctodæum.

The first bilaterally symmetrical division of the mesoblast occurs at the seventy-cell stage. In the entomeres a fifth quartet is formed and the three cells of the fourth quartet divide bilaterally. No further divisions occur before the closure of the blastopore.

The first bilateral division, in the small ectomeres, in the large X cell, in the mesoblast and in the entomeres all occur at very different periods in development but in the *same generation of cells*, viz., the eighth, counting the unsegmented egg as the first.

Gastrulation is a combination of invagination and epiboly. The mesoblast shows the first sign of invagination; then the entomeres also elongate inward until they form a column extending to the ectoderm of the upper pole. Now the ectomeres overgrow their lower surface from the sides and ventrally, forming a triangular blastopore with its short base directed ventrally. The cells forming the lateral and ventral lips of the blastopore are twelve derivatives of the third quartet of ectomeres and later form the stomodæum. The proctodæal region should probably be regarded as a part of the blastopore, for it is originally continuous with the rest of the opening. It becomes separated from the stomodæum by the postero-anterior concrescence of the somatic plate. The gastrula is bilaterally symmetrical and its axis corresponds to none of the principal axes of the adult.

During the closure of the blastopore the mesoblast bands are forming in the interior of the egg. In this case we have an actual change of the plane of the mesoblast bands through nearly 90°, *i. e.*, from nearly dorso-ventral to longitudinal. The first cells of the bands are given off almost ventrally, but with each successive division of the mesoblasts the direction of the spindle is more nearly longitudinal with respect to the egg, until finally the cells of the bands arise anteriorly from the mesoblasts.

A word concerning the cleavage of *Sternaspis scutata* may be added here. This was worked out as far as the 80-cell stage by the author of this paper and corresponds, cell for cell, with that of *Arenicola*, differing, however, as regards size and structure of blastomeres and order of their formation. Sixteen relatively large cells corresponding to the primary trochoblasts of *Arenicola* are formed, but *Sternaspis* possesses no prototroch and these cells form part of the ectoderm.

II. *The Oblique Cleavage and its Relation to the Mosaic Theory.* After a review of the positions held by Roux, E. B. Wilson, Driesch, Hertwig, etc., the following arguments were given against the mosaic theory as applied to the oblique cleavage.

1. The failure of cell-homology in a rapidly increasing number of cases.

2. The very different size and structure in different species of blastomores which have the same normal fate.

3. Experimental work. Professor Wilson and Mr. Crampton err in regarding the experiments of the latter on *Ilyanassa* as supporting the mosaic theory, for in most cases 'regeneration' occurs. Mr. Crampton himself states in the text that in ½ and ¼ embryos the endoderm cells are *completely* overgrown by ectoderm, and also gives figures illustrating the same fact. It is, of course, impossible for ectoderm cells, which normally cover only the outer surface of cer-

tain endoderm cells, to overgrow in the ½ and ¼ embryo all sides of these cells and thus completely enclose them, unless 'regeneration' or 'postgeneration' occurs. Consequently Mr. Crampton's so-called ½ and ¼ embryos have at least made an attempt to become whole embryos, and Crampton and Wilson are wrong when they state that the power of 'regeneration' or 'postgeneration' is entirely absent.

A number of other points in this work were mentioned as affording evidence against instead of for the mosaic theory, even as modified by Wilson.

In general terms, the oblique cleavage is, of course, the result of the organization of the egg. It may be pointed out that it is the form of cleavage which brings each cell into contact with the greatest number of other cells. It is certainly not 'mechanical' in Wilson's sense, for even the constant direction of obliquity cannot be explained in this way.

O. Hertwig's view of the organization of the egg cannot be regarded as sufficient to explain the facts. Examples were given showing the extreme differences in the allotment of yolk in different species even when the yolk was similarly placed in the unsegmented egg. There is an organization more fundamental than the visible one, which governs both the form of cleavage and the position of yolk in the blastomeres.

The egg appears to be a complex of substances possessing the power to produce an embryo and through this an adult, by a series of processes not as yet understood. Visible localization in the egg or early cleavage stages, which is only a localization of protoplasm and deutoplasm, does not necessarily imply a corresponding location of the morphogenetic factors. The facts rather appear to indicate that what we call the morphogenetic factors are the processes going on in the egg as a whole. Any strictly cellular theory of development must be inadequate, as Dr. Whitman has shown.

In the final analysis the organization of the egg is dependent on the structure of the 'idioplasm.' This would seem to favor Dr. Whitman's view that the egg has a definite organization from the start. The localization of protoplasm and deutoplasm, however, which we find in the mature egg must be acquired during ovigenesis.

C. M. CHILD.

TORREY BOTANICAL CLUB, MARCH 9, 1897.

THE Secretary announced the conditions of a grant now offered from the funds left by Professor Newberry for encouragement of research, to be supplied successively to zoology, botany, geology and paleontology. For the present year the award is offered in geology or paleontology to amount to $50.00, payable July 15, 1897, the competitors to belong to the Scientific Alliance of New York City.

The scientific program was then taken up, the evening being devoted to the subject of ferns, with papers as follows:

1. Mrs. Elizabeth G. Britton, 'Notes on some Mexican Ferns,' presented in Mrs. Britton's absence by Dr. Rusby, with exhibition of numerous specimens, including species of *Pellæa*, *Polypodium*, *Cystopteris* and *Cheilanthes*. Dr. Rusby, having been himself present at their collection, described vividly the tongue of hard, black lava on which the collectors walked, and which was filled with large cavities often forming caves, containing some accumulation of soil and crowded with a luxuriant growth of ferns, although in November and practically the winter season.

2. Mr. Willard N. Clute, 'The New York Stations for *Scolopendrium*.' Mr. Clute contrasted the wide distribution of the Hart's-tongue fern in the old world, from the Azores to Japan, with the extremely local North American occurrence, in five areas only, Mexico, Tennessee, central New York, Owen Sound, in Ontario and New Brunswick. The central New York locality was made known early in the present century through John Williamson, and was visited by Pursh in July, 1807, who found it five miles west of Syracuse on the farm of J. Geddes, where it has recently been rediscovered. About 1827 Wm. Cooper discovered it at Chittenango Falls, where Mr. Clute found hundreds of plants growing last summer. Mr. Clute described the Chittenango ravine and its ferns. On sunny exposures of the limestone walls of the ravine grow rue spleenwort and purple cliff-brake in

quantities; in shady places the slender cliff-brake; on the talus upon the larger bowlders the walking fern, and in the shade of these bowlders the Scolopendrium, chiefly in clusters of 2 to 6, at first erect, finally somewhat drooping, and ripe in September. Mr. Clute added that the species seems to be increasing at present, being now under the protection of an association.

3. The third paper was by Mr. B. D. Gilbert, of Utica, N. Y., entitled 'New and interesting Ferns from Bolivia,' with exhibition of specimens of two new ferns, a species of *Blechnum* and a new variety of *Nephrodium villosum*, the first peculiar in being fully pinnate, the second in being a one-sided dwarf persistently under a foot and a half high, instead of 4 or 5 feet as its type.

4. The fourth paper, also by Mr. Gilbert, 'Jamaica, the Fern-Lover's Paradise,' described the abundance of species and of individuals which the speaker had collected there, illustrating the subject by numerous specimens. He remarked that Swartz in his *Species Filicum*, 1783–6, enumerating all then-known ferns, described 709 species, of which 149 were from Jamaica; the Jamaican number was raised to 300 by Grisebach and now to 500 by resident botanists there, an estimate confirmed by Mr. Gilbert. Probably no other equal area produces half that number. Among reasons which account for this are the warm latitude of Jamaica, its south shore sheltered from cooler breezes by a mountain wall, its mountains themselves rising to 7,000 feet and reaching into a cool temperature climate, and its great variation in moisture, with daily rains in the mountains and sometimes but twice in six months on the plain.

Edward S. Burgess,
Secretary.

Boston Society of Natural History.

A general meeting was held January 2, 1897; forty-three persons present. Professor W. O. Crosby gave an account of the dike-like masses of sandstone that occur in the granite of the Pike's Peak massif in the Ute Pass, Colorado. For an Abstract see Science, page 604 above.

The Society met February 3d; one hundred and six persons present.

Mr. William C. Bates spoke of Venezuela and British Guiana, giving a brief historical account of their discovery, and describing, with the aid of a series of stereopticon views, various points of interest connected with their natural history, scenery and people.

Samuel Henshaw,
Secretary.

The Academy of Science of St. Louis.

At the meeting of the Academy of Science of St. Louis held on the evening of April 5, 1897, Professor Frederick Starr, of the University of Chicago, briefly addressed the Academy on the functions of such organizations, with especial reference to local problems. Mr. H. C. Irish presented a paper on the relations of the unfolding of plants in spring to meteorological conditions, in which were embodied deductions drawn from a series of observations made at the Missouri Botanical Garden, and those by other observers, extending back to the time of Stillingfleet, in the last century. Mr. Charles Robertson presented for publication a paper entitled 'North American Bees—Descriptions and Synonyms.'

Wm. Trelease,
Secretary.

Science Club of the University of Wisconsin.

At the regular meeting of the Club held March 11th the only paper of the evening was by Wm. B. Miller on 'Pulmonary Architecture.' The object of the paper was to show that in the structure of the lung there is a definite relation of the bronchi, blood and lymph vessels to each other; and that there is to be found in the lung the same as in the liver, intestines and other organs, a *unit* which repeats itself throughout the entire organ, and that when this unit is understood there is little difficulty in understanding the whole organ. The paper was illustrated by means of numerous models, macroscopic and microscopic preparations.

Wm. S. Marshall,
Secretary.

SCIENCE

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FRIDAY, APRIL 23, 1897.

CONTENTS:

The Inheritance of Acquired Characteristics: E. D. COPE 633
Organic Selection: J. MARK BALDWIN 634
What is a Type in Natural History? CHARLES SCHUCHERT 636
The Fauna of Central Borneo: GEORGE R. STETSON. 640
Sermon on the Monotremes: J. H. MCG 643
Notes on French Geography: F. P. GULLIVER 644
Current Notes on Physiography:—
Is Green River Antecedent to the Uinta Mountains? Santa Catalina Island, Cala.; Notes: W. M. DAVIS. 647
Current Notes on Meteorology:—
Winter Storms on the Coast of China: The 'Ities' Typhoon; Angot's 'The Aurora Borealis:' R. DEC. WARD 649
Current Notes on Anthropology:—
The Jewish Physical Type; On Wampum Records; The Otomis: D. G. BRINTON 650
Notes on Inorganic Chemistry: J. L. H. 651
Scientific Notes and News 651
University and Educational News 656
Discussion and Correspondence:—
Mr. Lowell's Observations of Mercury and Venus: EDWARD S. HOLDEN. *Further Considerations on the Systematic Position of Tarsius:* CHARLES EARLE. *The Coming Ice Age:* C. A. M. TABER. *The Smithsonian Table at the Naples Station:* CHARLES WARDELL STILES 656
Scientific Literature:—
Scott's Introduction to Geology: H. S. WILLIAMS. *Russell's Glaciers of North America:* HARRY FIELDING REID. *Meteorological Reprints:* R. DEC. WARD. *Goodman on Archaic Maya Inscriptions:* D. G. BRINTON 659
Scientific Journals:—
The American Chemical Journal: J. ELLIOTT GILPIN. *Terrestrial Magnetism; The American Physical Educational Review:* G. W. F. 664
Societies and Academies:—
The Scientific Association of the Johns Hopkins University: CHARLES LANE POOR. *The Biological Society of Washington:* F. A. LUCAS 667
New Books 668

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE INHERITANCE OF ACQUIRED CHARACTERISTICS.**

PROFESSOR COPE'S defense of the doctrine of the inheritance of acquired characters was selected from the evidence contained in his book, 'The Primary Factors of Organic Evolution.' He referred especially to the history of the moulding of the articulations of the vertebrate, and especially of the mammalian skeleton, of which such complete series has been furnished by paleontology. The forms of the articulations he believed to be the result of their movements, for the reason that they could be formed artificially, as the result of experiment, or in consequence of luxations. He believed that the resulting forms have been inherited, because they are found in the embryo before the animal has had an opportunity of developing the structure for himself by interaction with the environment.

He admitted the justice of Dr. Minot's demand for an explanation of this phenomenon. He stated that the preformationists offered no explanation, and, indeed so far as he could see, none was possible from their point of view. The epigenesisists could, on the contrary, appeal to the

* Abstract of Professor Cope's part in the discussion by Professors Minot, Macfarlane, Cope and James before the Boston meeting of the American Society of Naturalists, prepared at the request of the editor by the late Professor Cope.

phenomena of memory as a plausible explanation. Stimuli from without and from within the organism leave a record on the brain-cells which give the form to consciousness, when the latter invades them, along the guiding lines of associations. Why should not the germ-plasma be capable of a similar record of stimuli which is expressed in the recapitulatory growth of the embryo? He thought that the evidence pointed to such a process. These stimuli affected the soma and the germ-plasma simultaneously in accordance with the doctrine of Diplogenesis, but that the soma only records results in each tissue which are appropriate to the functions of the same, while the germ-plasma and brain-cells may record them all. The certainty of record in both cases he supposed to depend on the frequency and strength of the impression, as is known to be the case with the memory of the mental organism. Hence mutilations or single impressions are rarely recorded, while those due to the constant and habitual movements are recorded, and form the physical basis of growth and of evloution of type.

He further remarked that the belief that natural selection originates structure cannot be entertained, as paleontological evidence shows that evolution has proceeded by very gradual additions and subtractions of character, which required long periods to become of any value in the struggle for existence, sometimes an entire geological period being occupied in the elaboration of a character to structural usefulness.

Finally he referred to the physical mechanism of mental phenomena, and stated that some physiologists require a completed machine for the performance of special mental functions. The speaker called attention to the fact that the fundamental sensations do not even require a nervous system for their expression. Thus Protozoa appear to experience the sensations of hunger, temperature and the muscular sense of resistance. Hence it is as true of the physical basis of mental as of other functions that the function produces the structure, while structure merely specializes or perfects function.

ORGANIC SELECTION.

In certain recent publications* an hypothesis has been presented which seems in some degree to mediate between the two rival theories of heredity. The point of view taken in these publications is briefly this: Assuming the operation of natural selection as currently held, and assuming also that individual organisms through adaptation acquire modifications or new characters, then the latter will exercise a directive influence on the former quite independently of any direct inheritance of acquired characters. For organisms which survive through adaptive modification will hand on to the next generation any 'coincident variations' (*i. e.*, congenital variations in the same direction as adaptive modifications) which they may chance to have, and also allow farther variations in the same direction. In any given series of generations, the individuals of which survive through their susceptibility to modifi-

* H. F. Osborn, Proc. N. Y. Acad. of Sci., meeting of March 9 and April 13, 1896, reported in SCIENCE, April 3 and November 27, 1896. C. Lloyd Morgan, 'Habit and Instinct,' October, 1896, pp. 307 ff., also printed earlier in SCIENCE, November 20, 1896. J. Mark Baldwin, discussion before N. Y. Acad. of Sci., meeting of January 31, reported in full in SCIENCE, March 20, 1896, also *Amer. Naturalist*, June and July, 1896. The following brief statement has been prepared in consultation with Principal Morgan and Professor Osborn. I may express indebtedness to both of them for certain suggestions which they allow me to use and which I incorporate verbally in the text. Among them is the suggestion that 'Organic Selection' should be the title of this paper. While feeling that this cooperation gives greater weight to the communication, at the same time I am alone responsible for the publication of it.

cation, there will be a gradual and cumulative development of coincident variations under the action of natural selection. The adaptive modification acts, in short, as a screen to perpetuate and develop congenital variations and correlated groups of these. Time is thus given to the species to develop by coincident variation characters indistinguishable from those which were due to acquired modification, and the evolution of the race will proceed in the lines marked out by private and individual adaptations. It will appear as if the modifications were directly inherited, whereas in reality they have acted as the fostering nurses of congenital variations.

It follows also that the likelihood of the occurrence of coincident variations will be greatly increased with each generation, under this 'screening' influence of modification; for the mean of the congenital variations will be shifted in the direction of the adaptive modification, seeing that under the operation of natural selection upon each preceding generation variations which are not coincident tend to be eliminated.*

Furthermore, it has recently been shown that, independently of physical heredity, there is among the animals a process by which there is secured a continuity of social environment, so that those organisms which are born into a social community, such as the animal family, accommodate themselves to the ways and habits of that community. Professor Lloyd Morgan,† following Weismann and Hudson, has employed the term 'tradition' for the handing on of that which has been acquired by preceding generations; and I have used the phrase 'social heredity' for the accommodation of the individuals of each generation to the social environment, whereby the continuity of tradition is secured.*

It appears desirable that some definite scheme of terminology should be suggested to facilitate the discussion of these problems of organic and mental evolution; and I therefore venture to submit the following:

1. *Variation:* to be restricted to 'blastogenic' or congenital variation.

2. *Accommodation:* functional adaptation of the individual organism to its environment. This term is widely used in this sense by psychologists, and in an analogous sense by physiologists.†

3. *Modification* (Lloyd Morgan): change of structure or function due to accommodation. To embrace 'ontogenic variations' (Osborn), *i. e.*, changes arising from all causes during ontogeny.

4. *Coincident Variations* (Lloyd Morgan): variations which coincide with or are similar in direction to modifications.

5. *Organic Selection* (Baldwin): the perpetuation and development of (congenital) coincident variations in consequence of accommodation.

6. *Orthoplasy* (Baldwin): the directive or determining influence of organic selection in evolution.‡

7. *Orthoplastic Influences* (Baldwin): all agencies of accommodation (*e. g.*, organic plasticity, imitation, intelligence, etc.), con-

* This aspect of the subject has been especially emphasized in my own exposition, *American Naturalist*, June, 1896, pp. 147 ff.

† Introduction to Comp. Psych., pp. 170, 210, 'Habit and Instinct,' pp. 183, 342.

* 'Mental Development in the Child and the Race,' 1st ed., January, 1895, p. 364, SCIENCE, August 23, 1895.

† Professor Osborn suggests that 'individual adaptation' suffices for this; but that phrase does not mark well the distinction between 'accommodation' and 'modification.' Adaptation is used currently in a loose general sense.

‡ Eimer's 'orthogenesis' might be adopted were it possible to free it from association with his hypotheses of 'orthogenic' or 'determinate' variation and use-inheritance. The view which I wish to characterize is in some degree a substitute for these hypotheses.

sidered as directing the course of evolution through organic selection.

8. *Tradition* (Lloyd Morgan): the handing on from generation to generation (independently of physical heredity) of acquired habits.

9. *Social Heredity* (Baldwin): the process by which the individuals of each generation acquire the matter of tradition and grow into the habits and usages of their kind.*

J. Mark Baldwin.

Princeton University,
March 13, 1897.

WHAT IS A TYPE IN NATURAL HISTORY?

All naturalists concede that type specimens constitute the most important material in a museum of natural history. The true appreciation of this fact, however, is of recent date, and is shown in the numerous lately published catalogues of types possessed by different museums. The greater number of these publications have appeared in England and America. This just valuation of type material in recent years has come about through the work of specialists in their efforts to monograph groups of organisms. In those branches of natural history where original descriptions are usually accompanied by figures, the value of type material is not so apparent as where no figures are given, but in all branches of this science except bacteriology, it is upon the type material that the entities of natural history and its taxonomy rest. It is therefore of the greatest importance to learn the whereabouts of types. The object of this article, however, is not to point out the great scientific value of type specimens, but to determine what constitutes a type and what kinds of types exist.

There is considerable diversity of opinion as to what is meant by a type. One writer states that "By a type is meant the original specimen to which any generic or specific name was first assigned."*

The late Dr. G. Brown Goode writes that

> By a type is meant a specimen which has been used by the author of a systematic paper as the basis of detailed study, and as the foundation of a specific name. In cases where a considerable number of specimens has been used, it is desirable to separate one or more as being the *primary types*, while the other specimens, which may have been used in the same study for the purpose of comparison, may be regarded as *collateral types*.†

A mammalogist further states that "The word 'type' itself, when first introduced, was meant to refer to the particular specimen (in the singular) originally described, but it was soon naturally applied to any individual of the original series, if more than one specimen was examined by the describer."‡

These citations clearly show that a type is not always restricted to a single specimen selected by an author, but also applies to several, or even to all the specimens contained in the original lot. Moreover, the word type has been applied to specimens sent out by the author of a species, but not

* Professor Lloyd Morgan thinks this term unnecessary. It has the advantage, however, of falling in with the popular use of the phrases 'social heritage' and 'social inheritance.' On the other hand, 'tradition' seems quite inadequate; as generally used it signifies that which is handed on, the material; while in the case of animals we have to deal mainly with the process of acquisition. 'Social heredity' also calls attention to the linking of one generation to another. However, I think there is room for both terms. For further justification of the terms 'Social Heredity' and 'Organic Selection,' I may refer to the *American Naturalist*, July, 1896, pp. 552 ff.

*T. McKenny Hughes, Catalogue of the Type Fossils in the Woodwardian Museum, Cambridge, 1891; prepared by Henry Woods.

†Circular letter of July 1st, 1893, to Curators in the U. S. National Museum.

‡Suggestions for the more definite use of the word 'type' and its compounds, as denoting specimens of a greater or less degree of authenticity, by Oldfield Thomas. Proc. Zool. Soc. London, 1893, pp. 241–2.

described in the original paper. Students of parasitic insects often rear numerous individuals from a single mother of a new species, any one of which is naturally as much like the type as those selected by the author. Some of the individuals of such broods are distributed to other workers and museums as types. For a clear description of a new species a paleobotanist may require as many individuals as there are specimens selected for study, all of which are regarded as types. Because of the general imperfection of fossils, much of the original material is usually accepted by paleontologists as types, but when specimens are figured, as is the general custom, it is good practice to regard these alone as types. The writer is not aware that any invertebrate paleontologist in America ever considers a species to be based upon a single specimen, if others are present at the time of original publication. It is doubtful if many species, living or extinct, can be defined from a single individual; hence the multiplicity of types is generally a necessity. In birds and mammals, where the sexes usually exhibit marked differences, there are seasonal modifications, a bony skeleton, geographical and individual variation, and stages of growth, and all these parts and variations require material for the proper and final interpretation of species. The practice of selecting a single example as the type, however, has its advantages, since all doubt is thus removed when a new species is later found to contain diverse elements.

The writer believes that it is possible to harmonize all these different conceptions as to what constitutes a type. The following is, therefore, offered as an expression of individual opinion, in the hope that biologists will, when necessary, emend the different definitions here given or offer new ones, so that a proper terminology in regard to types may come into general use.

KINDS OF TYPES.

Type Material.—This includes all specimens which have served as the basis for published primary and supplementary descriptions and figures. Mere lists of names should not be regarded as based upon 'type material;' neither should typical undescribed specimens of the original series identified by the author of a new species, nor the reared original duplicates of a series out of which the type material was selected, be sent out to collectors and museums as types. There are, therefore, two great groups of type material: primary and supplementary types. These may be defined as follows:

Primary Types.—These are the described or figured specimens of any new species. There are three kinds of primary types: holotype, cotype and paratype. To these may be added a fourth, plastotype, including all artificial reproductions moulded directly from some primary type.

Supplementary Types.—These consist of the described or figured specimens used in publication in extending or correcting knowledge of a previously defined species. For such type material the term hypotype (*hypo*=under or sub, and *typos*=type) may be used. For artificial reproductions moulded directly from a supplementary type, *hypoplastotype* may be useful.

The collective term, 'type material,' therefore includes all specimens used in publications and upon which the entities of natural science are founded. 'Primary types' include only the material of a new species, while 'supplementary' or 'hypotypes' are those specimens supplementing knowledge of a previously defined species. The various kinds of primary types may be defined as follows:

Holotype (*holos*=whole or entire, and *typos*=type).—A holotype in natural history is a particular individual deliberately selected by the author of a species, or it

may be the only example of a species known at the time of original publication. A holotype, therefore, is always a single individual, but may embrace one or more parts, as the skin, skeleton or other portions. When a holotype is selected, but other specimens are also described, the latter must be known as paratypes. When no holotype is selected, and more than one specimen is described, all become cotypes. Therefore, the original material of any species cannot include a holotype and cotypes, but may include a holotype and paratypes, or all may be cotypes.

In cases where a holotype is selected, but no description or designation is given to distinguish it from the associated material, the holotype practically does not exist.

In cases where a holotype has been selected, but the diagnosis is found to contain more than one species, the remaining material will always constitute the paratypes. These will not necessarily remain as such under another name, but will always be the paratypes of the new species as interpreted by its author.

The author of a new species having failed to select a holotype, no subsequent author can do this for him. No just law is retroactive. However, there are two exceptions which appear not to violate this law: first, when the original definition includes two or more species; and second, when no holotype is selected and but a single example is figured. Further remarks on these exceptions follow:

In cases where a single individual is originally figured, no holotype being selected, and the original diagnosis is known to be based upon several examples, it is recommended that the figured one be regarded as the holotype by subsequent authors. The remaining material described will, therefore, be changed from cotypes to paratypes, since out of the original series the holotype has been selected. (See definition of cotype.)

Where the original diagnosis is without illustrations and contains more than one species based upon cotypes the first subsequent author is at liberty to select from these a holotype for the old species, adhering as far as can be ascertained to the intention of the original author. For the other new species, if any, he may select from the remaining cotypes, or from other material in his possession, the holotypes or cotypes of his new species.

In cases where a new species is not directly based upon material, but upon the published description of an earlier author, the specimens of the latter become the type material of the new species. The kind of type then present will depend on whether in the original description a holotype had been selected.

A species described or new and proving to be a synonym does not affect the type material of the species with which it is synonymous. All such synonymous material, however, should be carefully preserved and marked as holotype or cotype under the original name as well as under the one of which it is known to be a synonym.

Cotype (or associate type).—Cotype was introduced by Waterhouse, and is defined by Oldfield Thomas as follows: "A cotype is one of two or more specimens together forming the basis of a species, no type [holotype] having been selected. No species would have both [holotype] and cotype, but either the former [or holotype and paratype], or two or more of the latter." In cases where the cotypes are unmarked and cannot be distinguished from the balance of the original series the only safe plan to follow will be to regard all the original material of a new species as cotypes. If such specimens are sent out to collectors and museums they should be marked as cotypes.

Paratype (*para*=beside, and *typos*=type).—"A paratype is a specimen belonging to the original series, but not the type [holotype], in cases where the author has himself selected a [holotype]. It should, however, be one of the specimens * * * [described] in the original description." The present writer has removed from this definition of Thomas, the words 'mentioned or enumerated' and substituted 'described.' Specimens merely mentioned or enumerated add no characters to the description of a species. Lists of specimens giving measurements, however, do add to the knowledge of a species, and are to be regarded as type material, either as paratype, cotype or hypotype, as the case may be.

A paratype may be subsequently selected as a holotype when it proves to be a new species and is not the species to which it was originally referred.

Plastotype (*plastos* = formed or moulded, and *typos* = type).—Any artificial specimen moulded directly from a primary type. There are many specimens of this kind in existence, cast directly from fossils, and these are often quite as good as the originals. No models, however, can be included, since they are not cast from type material. Artificial casts made from supplementary material will become plastotypes if a specimen from which the reproduction was made is subsequently used for the founding of a new species.

In this connection it may be well to give a name to artificial casts made from supplementary types, since some have a very decided value. For instance, many artificial casts are in museums of one of the supplementary types of the trilobite Isotelus gigas, the only one preserving the ventral limbs. For such the term *hypoplastotype* may be useful.

In paleontology fossils are sometimes described and illustrated from artificial casts or squeezes made from natural rock cavities from which the fossils have been leached. Such plastotypes are not to be regarded as type material. The natural moulds from which they are made, however, should always be so considered.

TYPICAL MATERIAL.

Mr. Thomas has also proposed the terms 'topotype' and 'metatype.' The material to which these terms are applied has not served in publication, but simply refers to typical material, either derived from the type locality (topotype) or derived from the type locality and identified by the author of a new species (metatype).

These were defined as follows: *Topotype.*—'A specimen simply collected at the exact locality where the original type was obtained.' *Metatype.*—'A specimen received from the original locality after the description has been published, but determined as belonging to his own species by the original describer himself.'

Genotype (*genos* = race, and *typos* = type).—Genotype applies to any typical material of the type species of a genus. The material, however, should be, if possible, from the original locality of the species, or a genotype should also be a topotype or metatype. Therefore there may be as many genotypes of Lingula as there are museums having characteristic specimens of Lingula anatina.

MARKING OF TYPE MATERIAL.

All type material should be plainly and permanently marked to distinguish it from other specimens. If this is carefully done, much doubt will be removed for subsequent students. When such material is large, as birds and mammals, a small highly colored card or a piece of plain zinc may be attached, upon which should be printed or stamped the proper term indicating the kind of type and the museum catalogue number. In paleontology it is the custom to glue small colored tickets upon the type

material in addition to the catalogue number, when sufficiently large to permit of this without covering too much of the specimen. The small specimens are placed in numbered vials or boxes. In the Woodwardian Museum (Cambridge) type fossils are mounted on blue tablets. This arrangement, however, has the disadvantage of giving the exhibition series a checkered appearance, and should the specimens become loosened and displaced there is danger of the types being overlooked.

CHARLES SCHUCHERT.

THE FAUNA OF CENTRAL BORNEO.

IN 1893 the Netherlands Commission, established for the purpose of promoting research into the natural resources of the Dutch colonies, united with a similar society formed in Batavia composed of merchants, financiers and government officers in organizing an expedition of scientists to central Borneo, a hitherto scientifically unexplored region.

Herr Büttikofer was the zoologist of the expedition and presented an account of its results to the third International Zoological Congress, held last year at Leyden, and his report has since been printed in the *Compte-rendu* of the Congress.

To zoologists it is hardly necessary to say that Herr Büttikofer is the distinguished curator of the Zoologischen Reichs Museum in Leyden, and the author of 'Reisebilder aus Liberia' (Leyden, E. T. Brill, 1890), the best zoological and sociological study of that country which has been made, and which in its minute descriptions of animal life is superior to any work upon any part of the African continent with which we are acquainted.

The work of the expedition was divided into six departments: Geology, Mineralogy, Botany, Zoology, Anthropology and Ethnography. Of these geology and mineralogy were assigned to Professor Molengraaff, of Amsterdam; Botany, to Dr. Hallier, of Buitenzorg (Java); anthropology and ethnography to Dr. Nieuwenhuis, who was also medical officer; and zoology to Dr. Büttikofer, as before stated. Each had perfect control of his own department as to the field of research and the time to be spent. In anthropology and ethnography not much could be expected, as they require a much longer residence and acquaintance with the native populations than such expeditions usually afford.

"In my own department," says Herr Büttikofer, "I had the valuable assistance of a black man, Max Moret, a soldier in the Dutch army who had before accompanied Professor Selenka in his Borneo journey." "The natives became interested in my department and willingly lent me a helping hand."

Herr Büttikofer reached Batavia, November 1, 1893, and during his three weeks' stay in Java made an excursion to the Preanger regencies, and to the lofty mountains Gedeh and Pangerango, where he obtained among other specimens the very rare *Merula javanica*. Leaving Java on November 17th, he landed at Pontianak, on the west coast of Borneo, and ascending the mighty river, Kapuas, established a central station at Smitau. The river being in flood, the hunting was confined to birds and other tree-living animals, and many new specimens were obtained.

In December they moved on to Mt. Kenepai (1200 metres), near the borders of Sarawak, where on higher ground a better field was found. Ascending the mountains, they pitched their tents half way to the summit and found the life most romantic. "In the early dawn we were awakened by the loud jodelling of gibbons and the ear-splitting shriek of the Rhinoceros birds, after which, as the morning advanced, the other members of the winged orchestra joined in the chorus."

The rain and fog and the resulting humidity were very annoying, as the specimens dried at the fire when taken away, immediately became wet again. "The orangutans amused themselves by swinging in the tree tops over our heads." From the isolated peak of Kenepai the view was beautiful and disclosed here and there in the forest-covered plain the waters of the Kapuas and Kenepai stretching out into a chain of lakes; on the north Mt. Tutup reared its head, its foot hills forming the southern boundary of Sarawak.

Returning to Smitau in February, 1894, the specimens were prepared for shipment, and at the end of the month a new start was made for the Mandai river, one of the principal tributaries of the upper Kapuas, and having its source in a great group of mountains, which sends out the Mandai and the Melawi on the west, the Barito on the south, and the southern tributaries of the Mahakkam, on the east coast. Ascending the Kapuas to the mouth of the Mandai, the journey was pursued in small boats, through a flat, uninteresting and tiresome country, until the rapids were reached.

At Nanga-Raun, the next stopping place, reached in five days, they built a roomy hut. In that mountainous region, Herr Büttikofer chose for exploration Mt. Liangkubung. About 2,500 feet up its side he camped in one of the dry grottoes, inhabited by large numbers of the native Punans, and there remained from the 10th of March to the beginning of May, 1894.

The hunting, while rough and tiresome, gave excellent results, and many new specimens were procured, such as the *Sciurus whiteheadi* and the *Calyptomena hosei*, heretofore only known in north Borneo. Fresh foot prints of the rhinoceros were also seen; on the summit the only evidence of life in the grave-like silence was the forest blood-leech, the pest of the mountain climber in Borneo, which fell upon them murderously.

Returning to Poetoes Sibau on the 5th of May, Büttikofer and party went up the Sibau as far as Poelau, the only settlement in the whole Sibau valley, and again returning to Poetoes Sibau, joined Dr. Nieuwenhuis and Professor Molengraaf in the journey to the Mahakkam region. Concluding his *résumé* of the various journeys he remarks: "I confined my work to the region of the upper Kapuas, under the equator, because of the isolation of the district and the ignorance concerning it, and as a result I lack many specimens of species belonging to the coast."

The mammalia and birds of Borneo can best be compared with those of the known islands of the East Indian archipelago, and I have, therefore, few new specimens, although working in an entirely unknown region. This demonstrates that the fauna of the Kapuas region is identical with the Sarawak and upper Borneo. I am of the opinion, as a result of my observation, that the lateral diffusion of animals is of much greater interest than the altitudinal, and that this observation can be used to illustrate the speculative theory of the elevation and depression of the Malay archipelago and the island of Sundain.

While Borneo, from a zoo-geographical point of view, resembles Java and Sumatra and the adjacent islands, as well as the peninsula of Malacca, it nevertheless shows a constant tendency to deviate. For a good classification of the mammalia of Borneo we have to thank an Englishman, Mr. Chas. Hose, who gives 146 species, of which he has collected the greater part. The number found by me in the Kapuas region is about 66, divided as follows: Apes and Lemurs 12, Bats 18, Insectivora 10, Carnivora 7, Rodents 13, Artiodactyls 3, Perissodactyls 2, Edentates 1.

Among the mammalia the greatest interest centers on the orangutan, which is met with in the mountain region dividing Dutch

Borneo from Sarawak. It seems to avoid the valley forests as well as the higher altitudes, the central region of its dispersion being between Sambas and Batang Lupar-Seen. There they are so plentiful that Moret, who after my departure hunted for them to gather embryo material, found in that region alone 139 specimens in 3 months. How far north this distribution reaches cannot be ascertained from Mr. Hose, who himself does not seem to have met them. I conclude that the northern limit of distribution is not above southern Sarawak.

Eastward the distribution is limited, and it is not found east of Batang Lupar-Seen, and to the Sibau-Djaks it is only known by name. At the sources of the Kapuas it is not found. The cause of this limited distribution is not obvious, for the region of wild figs and similar fruit greatly exceeds its range and the climate does not vary. Another region in which it is found is the great alluvial plain of south Borneo, where it inhabits the swampy forests as far as the coast. The numerous specimens in the Leyden museum came from this region. Their color varies from a dusky red to a russet brown.

The attempt has been made to separate the dark varieties into a distinct species to which the name *Simia morio* has been given.

The orangutan lives exclusively in the tops of the trees and in his search for food covers a large territory; it does not like the gibbons, which are much more active, swing itself to a great distance, because of its great size, and is sometimes forced to descend. After eating it can be hunted with great ease by a practiced shot, but unless mortally wounded or shot in the arms it is impossible to bring it down. If a mother is shot with her young by her, the latter can be easily captured and readily tamed. The habit of the *Maias* (which is the Djak name of the orang) is to build itself a nest which he uses at night.

In the forests of the Kenepai, where it is often met with, we found so many of these nests that I am convinced that it does not occupy the same nest every night, but builds them when necessity requires. They are about the size of an eagle's nest, and are often found on small young trees; and not much skill or pains or uniformity of design is shown in building them.

The gibbon is much livelier and lives in small communities of five or ten individuals; it by preference inhabits the mountain forests, and I have found it at an attitude of 900 metres, while in the river valleys it is seldom found. They rush through the forest with great noise and crying, swinging from tree to tree; the Djaks call them *mblian*. The varieties are two, light and dark; the former named *Hylobates concolor*, the latter *H. Müller*i.

The proboscis monkey has his home on the banks of the rivers and never ascends the mountains. I found them near the mouth of the Palin river as it flows into the Kapuas. They live in small families of 5 or 8 and are not at all shy; a living specimen I obtained was quite white, and his nose was just a little elongated.

A very pretty animal is the lemur (*Nycticebus tardigradus*), most plentiful in the lower Kapuas, but not found much above Sintang; of these I collected several living specimens. The tarsier (*Tarsius spectrum*) is not rare in the lower river regions and is brought living, for sale by the Malays. On the day of my arrival at Pontianak, I bought a flying lemur (*Galeopithicus volans*), which I kept alive. Of the insectivora the *Tupaias*, or tree shrews, are most numerous. The *Gymnura alba* is much rarer and more interesting. The Malays, because of its nocturnal habits and appearance, call it *tikus bulan*, which means moon-rat; in color it is a dirty white with a stiff, spindle-shaped, naked tail. In the daytime it lives among the roots of the trees and burrows

in the ground, and is easily located by its musky odor.

The seven carnivora in the Kapuas region, with the exception of one cat, one otter, and the Malay bear belong to the civet cats and the *Ichneumons*. Of the 13 rodents the squirrels are the most numerous, and among them are two very pretty species, *Sciurus melanotis* and *Sciurus whiteheadi*. In the same locality we found the giant of the squirrels, *Rheithrosciurus macrotis*, which lives on the ground and is distinguished by a large bushy tail, and which is universally distributed over Borneo, but is nowhere plentiful. We also found flying squirrels and on the Kenepai a small species of porcupine

Of the artiodactyls, the deer family has three specimens — the sembar (*Cervus equinus*), the muntjac (*Cervulus muntjac*), and the small musk deer (*Tragulus kanchil*); all are common in the Kapuas region and are caught by the natives. I have already mentioned the Rhinoceros; the remaining animal is the bearded pig (*Sus barbatus*), which lives on the shores of the Kapuas and is very numerous. His food is preferably earth worms, which are so plentiful that in poling in the mud of the river one pulls out more worms than earth. Because of his light skin and scanty hair the wild pigs appear white. In closing Herr Büttikofer calls attention to the preponderance of the arboreal animals, and states that of the 66 species found by him 52 are arboreal. "This preponderence is not found elsewhere in similar geographical conditions, either in Celebes, Africa or America; a preponderance which cannot be due to the priority of beasts of prey living upon the ground, for, as has been shown, they play no part in Borneo, and the tiger is unknown. It must be due to the forest covering of the island and to the yearly floods."

This imperfect *résumé* of Herr Büttikofer's paper will, perhaps, suffice to indicate its value to the zoologist and to suggest to the layman its romantic interest. We shall anticipate the pleasure of reading the forthcoming report which is to contain the combined results of the Borneo expedition.

GEORGE R. STETSON.

WASHINGTON, D. C.

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*SEMON ON THE MONOTREMES.**

AMONG the contributions to zoological literature which have appeared in the reports of Dr. Richard Semon's expedition to Australia and the Malay Archipelago, perhaps none have more popular interest than the papers by Dr. Semon himself on the habits and development of the Monotremes.

Both *Echidna* and *Ornithorhynchus* were studied. In neither of these animals is maturity attained until the end of the second year. The male *Echidna* is considerably larger than the female. In both genera the testes increase greatly in size during the breeding season, and the female *Echidna* develops a marsupium which disappears when no longer required by the young. The breeding season of *Echidna* begins late in July, and *Ornithorhynchus* commences to breed a little later, or about the middle of August. A striking ornithic character is that eggs from only the left ovary are fertilized, although the right ovary and oviduct appear to be well developed. The usual number of ova is one in *Echidna* and two in *Ornithorhynchus*. The egg is fertilized before or about the time of its entrance into the oviduct, and is at this time about four millimeters in diameter and nearly spherical, but during its sojourn in the genital passages a shell, composed of keratin, is secreted, and the egg (in *Echidna*) increases in diameter to about fifteen millimeters by absorption of uterine secretions. Both animals are oviparous, and in *Echidna*

* Zoologische Forschungsreisen in Australie und dem Malayischen Archipel. Von Dr. Richard Semon. Zweiter Band, I. Lieferung. Jena, 1894.

the single egg is transferred by the mother to the temporary marsupium, where the young are hatched, the period from fertilization to hatching being about ten weeks. *Ornithorhynchus*, being an aquatic animal, develops no marsupium, and the eggs are said to be deposited in the burrow which the animal constructs, but upon this point Semon made no observations.

Most of Semon's studies of the development were upon *Echidna*. The Monotreme egg is strictly telolecithal, resembling the eggs of Sauropsids in many points. The four-celled stage shows two vertical cleavages at right angles, the blastomeres being exactly equal. Quite early in development the blastoderm is seen to consist of a layer, one cell in thickness, except near the middle, where a few cells lie deeper. These were called hypoblast by Caldwell in 1887, but Semon regards this apparently two-layered stage as a morula, since he finds that the blastoderm later resumes the one-layered condition which he calls the blastula. In the mode of gastrulation the Monotreme egg suggests the Anamniotic type, the invagination preceding or accompanying the formation of cœnogenetic entoderm, instead of following it as in Sauropsids and Mammals generally.

Late embryos of *Echidna* show external genital knobs, which become enclosed within the cloaca before the time of hatching.

Among observations on the fœtal membranes may be mentioned the persistent union of amnion and serosa (chorion), which is very similar to the condition described in Chelonia by Mitsukuri. During the latter half of the embryonic period the body lies between the allantois on the right and the yolk-sac on the left, the two structures being, for a time, of nearly equal size. The inner walls of the allantois become adherent, obliterating its cavity, except near the middle, while the outer surface, which is very vascular, unites with the chorion and serves undoubtedly as a respiratory organ, as in Sauropsids.

Some very interesting notes on the body temperature are recorded, which show that it bears no direct relation to season, age nor temperature of the external air. Temperatures taken in the cloaca, varied from 26.5° C. to 34° C., so that the Monotremes are in a sense midway between the so-called cold-blooded and warm-blooded animals in regard to body temperature.

J. H. McG.

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NOTES ON FRENCH GEOGRAPHY.

PAYS DE BRAY.

The even skyline seen in looking across from either side of the *vallée de Bray* between Neufchatel and Bauvais, in northwestern France, is a most marked feature in the landscape. One rides over the even chalk upland to come suddenly upon the crest of an escarpment that descends steeply before him. He there looks across a lowland and sees a similar escarpment ascending upon the farther side, whose elevation above sea-level is about the same as that of the crest upon which he stands. After descending and crossing the different formations with varying structures appropriate to the half dome, cut off on the east by a series of faults which is the main structure of the Pays de Bray, he ascends the other side of the lowland and finds himself again on a Chalk upland exactly like that which he left. One at first sight might suppose that here is the uncovered base of a dome which had been baseleveled and later covered by horizontal Cretaceous beds. The exceedingly level skyline lends countenance to this view, but even a hasty inspection of the region shows that this is not the case.

The production of the even upland is subsequent to the uplift of the half-dome, which once must have risen higher than the present upland. Two reasons for this are

as follows: The Chalk, although nearly horizontal, sympathizes with the arching of the Portland oolites in the Upper Jurassic, the Lower Cretaceous, and the Gault series, which formations make up the half-dome as at present revealed by denudation; and the Chalk is also faulted with the other Mesozoic rocks.* The second reason for regarding the remarkably even upland of the Chalk as produced by baseleveling after the up-arching and faulting is found in the arrangement of the surrounding streams. The drainage to the southwest of the half-dome, which is the side where the arching is but little broken by faults, likewise shows the influence of the dome form during the initial stages of dissection which followed the uplift of the region. The radiating arrangement of the streams, la Varenne, Cailly, Robec, le Heron, Andelle and Eple indicates initial and consequent courses upon the western side of the half-dome.† Subsequent branches of the Eple and Bethune have discovered the weaker members of the Pays de Bray half-dome. In a word, the whole drainage system of the region between the Seine and the English channel is in accordance with what one would expect to find upon an area including a baseleveled half-dome, slightly elevated and dissected to youth or adolescence in the second cycle. Moreover, the adjustment of the drainage to the structure of the half-dome is so perfect that one cannot believe that the elevated region was a gently sloping coastal plain upon whose surface consequent streams became superposed upon a baseleveled and buried half-dome. The amount of dissection in the present cycle is not sufficient to allow of such perfect adjustment of stream to structure as we find to-day in the Pays de Bray.

* See *Le Pays de Bray*, by Professor A. de Lapparent, Paris, 1879, pp. 11, 116, 141.

† See Neufchatel and Rouen sheets, Nos. 20 and 31, Carte topographique de l' Etat-Major, 1 : 80,000.

BLIND VALLEYS AND SINKS.

IF one goes westward from the Pays de Bray, across the exceedingly level upland to the cliff above the straight shoreline of the English channel, where the coast has been developed to maturity by the vigorous action of the Atlantic waves cutting into the Cretaceous rocks, he will find remnants of drainage systems left upon the edge of the upland. These remnants appear to have been branches of a river that was situated where the English channel now is found. The remnants are evidently cut by flowing streams of water upon the surface of the land, though at present the valleys descend gently toward the cliff and there precipitously pitch into the ocean,* and thus evidently depart from the grade of a normally developed one-cycle stream.

In marked contrast to these evident subaërial remnants are the blind valleys seen upon the surface of the upland between the Pays be Bray and the coast, similar to those described in Austria.† One enters a small valley and follows it down for some distance seeing nothing in its form to lead him to suppose that it is anything but a normal branch of some river system. All at once he comes upon a plain area opening out from the comparatively narrow valley. The plain is a sink, surrounded on all sides by higher land sloping gently toward its center.

A typical young form of sink with three blind valleys beginning to develop, working back slowly from the central hole, is shown by M. Mantel in the plan of Mas Razals.‡ Slightly older forms are figured by the same writer at Aven de Hures, Igue de Baou, Igne de Planagreze and Pouor de Cettinje.§

* See French map 1 : 80,000; St. Valery, Abbeville, Yvetot sheets, Nos. 10, 11 and 19.

† Tietze. Jahrb. k. k. geol. Reichsanstalt, XXX., 1880, 738; Supan. Kirchhoff's Landerkunde von Europa, 1(2), 1889, 288.

‡ Les Abimes, Paris, 1894, p. 184.

§ Loc. cit., pp. 225, 302, 335, 486.

MM. de la Noë and de Margerie have shown similar forms in eastern France north of Besançon.* The combination of blind valleys and sinks gives various forms; the greater the number of subterranean passages for the water, the greater will be the irregularity of the surface. The simplest type of a blind valley is found where a single valley gently descends on a continuous grade to a flat depression of little or no greater width, under which is the subterranean outlet for the water. The method of formation of the passages below the surface of the Chalk is discussed in the chapter on subterranean water in Mantel's Les Cevennes (Paris, 1890) and in his Les Abimes.

MARAIS DE SAINT GOND.

Map of France, 1: 80,000, sheet 50. Chalons, S. W.

Upon a recent trip up the valley of the Petit Morin, toward the open Champagne, it was observed by the writer that the floor of the valley that trenches the Tertiary upland was aggraded for the whole distance from a point a few miles west of Montmirail (sheet 40) up to the head of the St. Gond marsh. There are places where the valley sides approach each other more closely, leaving a narrower aggraded bed, thus indicating more resistent layers in the Lower Tertiary or Upper Cretaceous strata, and hence harder work for the Petit Morin-Somme-Vaure when it was cutting the valley, now aggraded, before the capture of the headwaters by the Soude.† Professor Davis has shown that the diminished volume of water in the Petit Morin would necessitate aggradation. The smaller amount of water is not able to carry off the same amount of detritus which is still washed down from the same slopes. The soil creeps down, the storms wash much fine detritus from the slopes into the valley bottom, and the small side streams, which now are as able to do the work given them as before the capture of the headwaters of the Petit Morin, also carry much waste into the valley. At the western end of the marsh, near St. Prix, the little side stream entering here from the north has brought in considerable detritus, but this is only one of the minor factors in the production of the Marais de Saint Gond.

The Petit Morin has lost the greater part of its drainage area. It had developed a good-sized adolescent valley, particularly broad east of the hard rocks which form the great Tertiary escarpment of the Paris Basin. Since the loss of its headwaters it has been compelled to aggrade throughout the greatest portion of its course, thus causing many small swamps in the lower narrow valley and a broad marsh, le Marais de Saint Gond, at the upper limit of the beheaded Petit Morin. The present condition is one of unstable equilibrium. The small stream at the elbow of capture of the head waters of the Petit Morin by the Somme-Soude, in the small village of Ecury-le-Repos, will soon cut through the low divide, on account of the steeper grade of the Somme, and will drain the Marais de Saint Gond near the village of Morains.*

THE AGGRADING BAR.

The little wriggling bar staggering blindly along in a broad meandering valley is like a small boy attempting to fill his grandfather's boots. The waste supplied from the sides of the adolescent valley, cut by the ancestor of the present stream, is much too great a load for a little brook. Beneath the recent deposits of the bar, Professor de Lapparent has found, by means of excavations lately made, a deposit of argillaceous green sand, which must have been transported from the basin of the Aire when

*See fig. 1 in Les Formes du Terrain.

†See the Seine, the Meuse and the Moselle, by W. M. Davis, Nat. Geog. Mag., VII., 1896, 197-202.

*See Atlas Cantonal, Département de la Marne, 1: 50,000, sheet No 5, Canton de Vertus.

that stream was a tributary of the Meuse and flowed through the valley now occupied by the beheaded bar.

This geological confirmation of the geographic interpretation of the river captures in this region made by Professor Davis* is interesting on account of the reversal in the order of the observations from those made in the case of the capture at Toul.† That the present upper Moselle formerly joined the Meuse was first argued from the presence of pebbles in the valley of the Meuse which must have come from that of the Moselle above Toul. The strong geographic argument from the form of the valleys later corroborated the geologic evidence. Now we have the geologic added to the geographic evidence for the turning of the Aire by the Aisne from the drainage system of the Meuse to that of the Seine.

One of the sources of the present Bar has been turned by man recently, so that it now increases the water supply of the Briquenay, the reversed portion of the subsequent Aire-Bar. This change of a watercourse for industrial purposes is a continuation of the work begun by nature. The broad aggraded floodplain of the Bar is being taken advantage of this year, and a railway has been constructed along it between Sedan and Vouziers, with a branch running to Buzancy.

F. P. GULLIVER.

BERLIN.

*Loc. cit., p. 232.

† Loc. cit., p. 228.

CURRENT NOTES ON PHYSIOGRAPHY.

IS GREEN RIVER ANTECEDENT TO THE UINTA MOUNTAINS?

A RECENT paper by J. D. Irving ('Stratigraphical relations of the Brown's park beds of Utah,' Trans. N. Y. Acad. Sci., XV., 1896, 253–259), says: "It is a fact no longer disputed that these deep cañons in the quartzite by which Green river crosses the Uinta mountains were first established in the softer overlying formations, and that these formations furnished much of the corrosive material by means of which the harder rocks were cut away." It is not clear whether the overlying formations here mentioned were higher members of the Uinta arch or unconformably overlying Tertiaries. If the former, the writer would support Powell's explanation of the antecedent origin of the river; if the latter, he would support Emmons' view that the river is of superposed origin. In either case discussion on the question is hardly closed. Indeed, considering how frequently the Green is referred to as an antecedent river, it is remarkable that so little attention is given to the doubts that have been expressed regarding that manner of origin and to the difficulties that such an origin involves. Two recent text-books on geology credit the antecedent explanation. Tarr says: "In some cases the uplift of mountains appears to have been so slow that rivers have been able to maintain their courses across them as they rose; at least this is the interpretation placed upon some rivers, such as the Green river of Utah, which cuts directly across the high Uinta mountains' (Elementary Geology, 1897, 319). Scott is more cautious: "A famous example of what many authorities believe to be an antecedent stream is the Green river in Wyoming and Utah. Entering from the north, the river cuts its way in a winding course through the great mountain barrier of the Uintas in a remarkable series of cañons. This explanation is not accepted by all the observers who have examined the region; some of them explain the phenomenon by the theory of superimposed drainage" (Introduction to Geology, 1897, 325).

The Green river was unquestionably laked by the uplift of the Uinta range, and to this extent it is a defeated and not an

antecedent river. Between its two meridianal portions, north and south of the range, the river makes a great bend to the east, turning from the higher towards the lower part of the uplift—a remarkable coincidence, if this was an antecedent turn. It should further be noted that argument by which the antecedent origin of the Green was first supported, involved a similar origin for a number of smaller streams, although there can be little question that most or all of the latter are the result of headwater erosion along the strike of weak strata. Finally, the antecedent origin of the Green gives no adequate explanation to the broad depression of Brown's park near the eastern end of the mountains and chiefly within the rimming ridges. The paper by Irving, above named, explains the Brown's park beds as due to a lake formed by a slight uplift which dammed the river, but gives no consideration to the origin of the park itself. This, as well as the origin of the river, deserves careful study, in view of the frequent reference made to the region in geological writings. As the problem stands to-day, the Rhine in its gorge through the Schiefergebirge, in its middle course, is a better proved example of an antecedent river than the Green in its canyon through the Uinta mountains.

SANTA CATALINA ISLAND, CALA.

A study of this interesting island has been made by W. S. T. Smith (Geology of Santa Catalina Island, Proc. Cal. Acad. Sci., I., 1897, 1–71), following a brief description of some of its physical features by Lawson three years ago. It is gratifying to see that Smith recognizes as a chapter of geology the processes of taking away as well as those of giving; the work of denudation as well as that of deposition. Both these processes are plainly involved in any discussion of geology as a matter of earth-history, although it has often enough been the fashion to treat the 'geology' of a region as if it were concerned with composition, structure and deformation alone, giving only the briefest attention to denudation. Certainly, old mother earth has been about as much occupied with the latter as with the former, and our attention might be equally well distributed. Whether this chapter of geology shall be called geomorphogeny or geomorphy, or whether it affords appropriate material for these notes, is a less important matter.

Santa Catalina is regarded as a block broken from a much greater area of deformed basement rocks when the region was part of the mainland. Since then it has been dissected, partly covered with lavas, depressed so as to form an island, and the still emerged part denuded almost to a peneplain; then elevated, again dissected, and again depressed. The argument leading to this succession of events is well sustained. At present the shores are rapidly cut back by the sea. The gap in the island ridge where drowned valleys enter from either side, forming bays with with beautiful concave beaches, is explained as a local sag or structural depression.

NOTES.

Further account of the Lammbach disaster on the north side of Lake Brienz, Switzerland (see Science, Jan. 1, 1897), is given by C. Schmidt, of Basel (der Murgang des Lammbaches bei Brienz, Schr., Gesellsch. Urania, Berlin, no. 43, 1896), with a number of excellent illustrations. Most peculiar is the abrupt termination of the stony flood at certain points, where its margin resembles that of a thin lava flow.

The Geology of the Fox Islands, Maine, a dissertation by G. O. Smith, of Johns Hopkins University (1896), includes a brief account of their geography. The islands are hills rising over the broad floor of the

half-drowned Penobscot valley. Small modifications of form are ascribed to glacial action. The processes of to-day cut back the salients and fill the re-entrants of the shore line.

'GLACIAL flood deposits in the Chenango Valley,' described by A. P. Brigham (Bull. Geol. Soc. Amer., VIII., 1897, 17–30), are good examples of forms produced by the constrained drainage of the retreating glacier, passing from the Mohawk valley, over a divide and through the plateau country on the south, to the Susquehanna.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON METEOROLOGY.

WINTER STORMS ON THE COAST OF CHINA.

Two noteworthy publications come to us from the Shanghai Meteorological Society. They are the 3d and 4th Annual Reports of that Society, and were prepared by Rev. S. Chevalier, the energetic President of the Society, and Director of the Zi-Ka-Wei Observatory, at Shanghai. The first is entitled an 'Essay on the Winter Storms of the Coast of China,' and the second, which is really a part of the same investigation, concerns 'The Variations of the Atmospheric Pressure over Siberia and Eastern Asia during the Months of January and February, 1890.' Both of these monographs furnish valuable information concerning the meteorology of the eastern coast of China. Among the results of Father Chevalier's study we note the following: The cyclones which travel across Europe and reach western Siberia experience great difficulty in crossing this region, and are generally driven off towards the North Pole by the anticyclone over Siberia, but some may cross the whole of Asia directly from west to east, or else may be deflected to the southeast towards China. These depressions over Siberia affect the weather on the coast of China indirectly. There are, in addition, cyclones developed over China or further west, which cross the Chinese coast with an east or northeast movement, and it is such cyclones as these that precede the winter storms on the coast of China. The gale in these storms bursts more or less suddenly after the passage of the center, and depends for its violence on the depth of the depression, as well as on the height of the succeeding cyclone in the rear.

THE 'ILTIS' TYPHOON.

THE somewhat remarkable typhoon, which resulted in the loss of the German gunboat 'Iltis,' with all her officers and the majority of her crew, during the night of July 23–24, 1896, in the neighborhood of the Shantung Promontory, on the coast of China, has been made the subject of a special study by Rev. Louis Froc, S. J. The results are published by the Zi-Ka-Wei Observatory in a monograph entitled 'The Iltis Typhoon, July 22–25, 1896.' The conclusions reached by the author are interesting. He says: "There is never any advantage in undertaking a struggle with a typhoon. Even with the powerful forces which our great steel liners carry within their breast, prudence is yet in this instance a good adviser, and a safe anchorage is far better than the risks of a wrestle; no time is gained thereby, and the vessel is exposed, if not to a fatal loss, at least to serious damages. Several steamers (in this typhoon) were kept back, despite the force of their engines, in the neighborhood, or even drawn in towards the center of the hurricane." The swell from this typhoon was noted 500 miles in front of the advancing center. There was a marked fall of the barometer 310 miles from the center, and the lowest pressure recorded was 27.97 inches.

ANGOT'S 'THE AURORA BOREALIS.'

AN English translation of Angot's 'Les Aurores Polaires' appears as Vol. LXXVII.

of the International Scientific Series (D. Appleton & Co.). This book has already been reviewed in SCIENCE (Vol. II., 107–108), so that extended comment on the translation is not necessary. The volume presents an interesting and complete account of the aurora in all its aspects, and will prove a valuable addition to scientific libraries. We note that the title page and cover give the title as 'The Aurora Borealis,' while the headings on the even pages all through the book give it as 'The Polar Aurora.' There are several illustrations of different forms of the aurora, but we do not find any index.

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CURRENT NOTES ON ANTHROPOLOGY.

THE JEWISH PHYSICAL TYPE.

THE peculiar physical type which we call 'Jewish' is as easily recognizable in the sculptures from Tello and Nippur, carved two or three thousand years before the Christian era, as it is in the satirical comic papers of our own day. The most prominent trait is the nose, which has the curve of an italic figure *6* reversed.

This is sometimes called the Semitic type, but erroneously, as the purest Semites, the Arabians of the desert, do not exhibit it. We must, therefore, seek its origin elsewhere. In an article read before the Munich Anthropological Society, printed in the *Correspondenzblatt* for January, Professor Oberhummer agrees with von Luschan in attributing it to the ancient Anatolian people, probably of Caucasic (Alarodian) affinities, residents in Armenia before the Aryan Armenians possessed the land, and whose branches were the Elamites and Susians of the south. These, by intermarriage with the Semitic invaders, impressed upon them this physical type, though not their language or culture.

This theory does not fully explain the prevalence of this type in Palestine, unless we allow a larger intermingling there of foreign blood than has been customary with historians.

ON WAMPUM RECORDS.

THE last scientific contribution prepared by our late eminent colleague, Mr. Horatio Hale, is printed in the *Journal of the Anthropological Institute* for February, 1897. It is entitled 'Four Huron Wampum Records; a study of Aboriginal American History and Mnemonic Symbols.' His usual patient research and careful deduction are well exemplified in it. The manufacture of wampum, its earliest use as a form of record, and the origin and meaning of the symbols woven into the belts, are fully discussed. Much collateral information on the history of the Hurons and Iroquois and on the formation of the famous 'League' is added.

A note is appended by Professor E. B. Tylor, which reviews Mr. Hale's conclusions and suggests further lines of research relating to the subject. He argues that the wampum *belt* had its origin among the Iroquois.

The studies on this question are yet far from completeness, as wampum was merely a method of arranging beads for mnemonic symbols, a custom widely prevalent in savagery and branching in many directions.

THE OTOMIS.

ACCORDING to the traditions of the Aztecs, their predecessors in Central Mexico were the Otomis, an undersized dark people, described as stupid and barbarous and speaking a tongue most cacophonous and difficult. Many thousands of them still survive on the Mexican plateau, but our actual knowledge of them is very scant.

A few years ago Judge Eustaquio Buelna published a grammar and dictionary of their language, composed by a Jesuit mis-

sionary about 1770 ('Luces del Otomi,' pp. 303). We have others, but it is one of the most valuable, and is carefully edited.

The assertion has been several times advanced by Mexican writers that there is a relationship between the Otomi and the Apache, that is, the Athapascan stock. I made a careful comparison of one hundred test words between the two groups, and sent the results to the Congress of Americanists at Stockholm, but I am informed that the paper has been lost. It showed that a sufficient number of verbal similarities exist to render either linguistic relationship or admixture probable.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

IN a recent number of the *Comptes Rendues* P. de Wateville describes a method of growing crystals with a transparency and luster analogous to those of cut and polished stones. The small crystal is so mounted that while growing in a saturated solution it can be continuously rotated on itself with a speed of several rotations a second. In alum crystals thus grown at 50°, dodecahedron and cube faces progressively disappear, those of the octahedron alone finally remaining. Potassium and ammonium alums, copper sulfate and sodium chlorate are said by the author to give particularly fine results.

IN the *American Chemical Journal* for April Professors Jackson and Comey, of Harvard, describe a peculiar hydrogel formed by the action of nitric acid on potassium cobalticyanid. When a strong solution of the latter salt is boiled with an equal volume of concentrated nitric acid for two hours it suddenly changes into a dark red semi solid gelatinous mass. This jelly is insoluble in acid or salt solutions, but somewhat soluble in cold or boiling water, and more so in water at 60°. This solution can be evaporated without gelatinizing, and the residue from evaporation when moistened with water decrepitates with a series of insignificant explosions to a red powder, almost insoluble in cold water, but somewhat soluble in water at 60°. The formula from analysis is $KH_2Co_3(CN)_{11},H_2O$, provisionally called monopotassium cobaltocobalticyanid. Several other salts (barium, silver and copper) of the acid were made. A similar jelly has been formed by the authors by the action of nitric acid on potassium ferricyanid. On boiling potassium ruthenium nitrosochlorid, K_2RuCl_5NO with potassium cyanid in quantity insufficient to convert it into the ruthenocyanid, the writer has obtained a similar hydrogel with almost identical properties.

ACCORDING to the recently published report of the Russian Department of Mines for 1895, the production of platinum for that year was 9,700 pounds, a decrease of 1,700 pounds from that of the year preceding. The production of all other mineral products showed a decided increase, except that of gold, which decreased slightly. The largest relative increase was in mercury, the production of which, 500 tons, was more than twice that of the previous year.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

AT a meeting of the Academy of Natural Sciences of Philadelphia, held the 13th inst., the following was unanimously adopted: The Academy of Natural Sciences, of Philadelphia, has received, with profound sorrow the announcement of the death of Professor Edward Drinker Cope. It is fitting that this meeting should place on record a minute expressive of its sense of the loss sustained. The Academy witnessed the beginning and the end of his long labors. It was to its halls he came as a student in 1859 and it was to them he paid his last visit before his final illness. The lustre thrown upon the society by his researches is but a reflex of the spirit of this remarkable man, who exibited,

in a way rarely equalled in the history of science, the consecration of a powerful intellect to the pursuit of the knowledge of nature. To an almost unerring accuracy of observation he conjoined admirable judgment. He was unexcelled as an expert in the field of vertebrate zoology of both present and extinct forms; he discovered great numbers of genera and species; he announced startling and epoch-making schemes of classification; he framed comprehensive systems of philosophy based on biologic premises. One hesitates which to admire the most, the tenacity of his memory, the brilliancy of his wit, or the ease with which he used his enormous erudition. To any community and at any time the loss of such a man is a calamity.

Mr. M. E. D. Trowbridge writes from Detroit that Professor F. W. Putnam, Permanent Secretary of the American Association for the Advancement of Science, visited Detroit on the 8th inst., in the interests of the meeting to be held in this city next August. He reported himself highly pleased with the facilities offered by the new high school building for the accommodation of the several sections of the Association. At present there is promise of a most successful meeting. Local committees are at work to provide interesting features for the entertainment of their guests. While in the city Professor Putnam spoke upon the Ruins of Copan, Honduras, under the auspices of the Detroit Archæological Society. There was an interested audience of 2,500 people. Professor Putnam was introduced by Professor M. L. D'Ooge, of the University of Michigan, President of the Detroit Archæological Society.

A conference was held on April 15th by Provost Harrison, of the University of Pennsylvania; President Schurman, of Cornell University, and President Low, of Columbia University, at the house of the latter, at which it was decided to ask Congress not to change the present law in regard to apparatus, books, etc. imported for public institutions. All the leading newspapers, Republican as well as Democratic, have protested against the imposition of a tax on science, literature and art, and it seems unlikely that the Senate committee will disregard this unanimous expression of public opinion.

Mr. H. Wilde, President of the Manchester Scientific and Literary Society, has given the Paris Academy of Sciences the sum of £5,500 to be used for an annual prize of 4,000 fr. for a discovery or publication in physical science. The prize is to be international. Mr. Wilde states that he has made this gift as a return for the benefit he has drawn from French science.

M. Radau, the astronomer, has been elected a member of the Paris Academy of Sciences in the room of the late M. Tisserand.

As we have already noted, the British Medical Association will hold its sixty-fifth annual meeting in Montreal, beginning on August 31st. The address of the President-elect, Dr. Roddick, will be on medical education in Canada. The address in medicine will be by Professor W. Osler, of Johns Hopkins University, and that in surgery by Mr. W. M. Banks, of Liverpool.

The Board of Managers of the New York Zoological Society held a meeting on April 13th at which the plans of the park were discussed and especially the methods to be used in collecting the needed $250,000. Several subscriptions of $5,000 and others for smaller amounts were made by the managers.

Professor Léon du Pasquier, of Neuchâtel, died after a brief illness on April 1st in his thirty-third year. He will be recalled by geologists as one of the most accomplished expert guides during the excursions offered in connection with the International Geological Congress at Zurich in 1894, and as author of a number of essays on the glacial geology of northern Switzerland.

Dr. G. A. Kenngott, professor of mineralogy at Zurich, died on March 14th, aged seventy-nine years. He had made important contributions to crystallography and petrography and was one of the editors of 'Handwörterbuch der Mineralogie, Geologie and Paläontologie.'

We also regret to record the deaths of Dr. F. W. Klatt, known for his contributions to botany; of Dr. Ludwig Hollaender, a writer on anatomy of the teeth; of Dr. Schols, professor of geology in the Polytechnic Institute at Delft; of Dr. Alfred Dewèore, the botanist; of Dr. Thollen, the geologist; of Dr. Ed. Freiherr

von Härdtl, astronomer at Innsbruck, and of Dr. Jacob Breitenlohner, professor of meteorology at the Agricultural School of Vienna.

AT a meeting held April 13th the Academy of Natural Sciences of Philadelphia conferred the Hayden Memorial Award for 1897, consisting of a bronze medal and the interest of the special endowment fund, on Professor A. Karpinski, the Chief of the Geological Survey of Russia, in recognition of the value of his contributions to geological and paleontological science.

PROFESSOR H. A. ROWLAND, of Johns Hopkin's University, has been elected an honorary member of the Royal Society of Edinburgh.

DR. GEORGE M. DAWSON, Chief of the Geological Survey of the Dominion of Canada, has been awarded the gold medal of the Royal Geographical Society of Great Britain, in recognition of his services in the surveys and maps of British Columbia, the Northwest Territory and the Yukon region.

ARRANGEMENTS are being made for the erection of a monument to Johannes Müller, in Coblentz, the place of his birth.

SIR JOHN EVANS, Treasurer of the Royal Society and President-elect of the British Association, has been elected a corresponding member of the Bologne Academy of Sciences in the room of Huxley.

DR. NANSEN lectured before the German Geographical Society on April 3d. The Society bestowed upon him the gold Humboldt medal. It was also announced that the Emperor had conferred on him the gold medal for science and art, 'the highest distinction which can be bestowed in Germany for peaceful achievements.' Dr. Nansen subsequently lectured at Copenhagen before the Danish Geographical Society, and received from the king the gold medal of merit with the royal crown.

LIEUTENANT ROBERT E. PEARY, now on duty at the New York Navy Yard, was detailed to Mare Island, Cal., by Secretary Long, but the order has been revoked at the request of those interested in the continuation of Lieut. Peary's Arctic explorations.

MR. ROBERT B. YOUND has been appointed Assistant Biologist at the Department of Agriculture, and will be assigned to work in Oregon and Washington.

THE daily papers report that the building of the College of Agriculture of the University of California at Berkeley has been burned, the loss being estimated at $400,000.

THE Governor of Florida has issued a call for a National Fisheries Congress to assemble at Tampa, Fla., on the 19th of January, 1898. The National Fishery Commission will take a prominent part in the proceedings, and the Governors of the different States are requested to send delegates. Governor Bloxham states that it is necessary to devise means to save from total extinction many varieties of valuable food fish.

THERE will be held an international fisheries exhibition at Bergen, Norway, from the 16th of May to September 30th of next year.

THE International Congress of Hygiene and Dermatology will be held in April next year, instead of this year, as was intended.

THE American Medico-Psychological Association will meet at Baltimore from the 11th to the 14th of May.

THE fifth International Congress of Criminal Anthropology will be held at Amsterdam in August, 1901.

THE New York Microscopical Society held its 18th annual exhibition on April 14th, at the American Museum of Natural History. There were nearly one hundred exhibits, which were examined with interest by a large number of visitors.

CHAS. SCRIBNER'S SONS announce the early publication of a series of volumes containing the 'Princeton lectures' delivered by distinguished foreigners during the week preceding the public sesqui-centennial exercises of Princeton University.

A NEW review for psychology and cognate subjects, including mental pathology, is announced to appear in Rome. It will be edited by a board of scholars, of whom Dr. Sancto di Sanctis, of the University of Rome, is to be Editor-in-Chief. Professor G. Sergi, the well-

known psychologist, is one of the directors of this review.

At the beginning of April a new American monthly entitled *Marine Engineering* was established.

Professor I. P. Roberts, Director of the Agricultural College, Cornell University, announces that the College has undertaken to assist teachers and parents interested in nature study by distributing, free of charge, leaflets giving instructions for the making of accurate observations of common objects.

An editorial article in *Garden and Forest* includes a letter addressed to the Secretary of the Interior by the committee of the National Academy of Sciences appointed to consider the forestry policy of the government, which outlines the report, which will shortly be presented. This letter states that the report now in course of preparation provides: (1) That authority be given to the Secretary of War to make details of troops to protect, until a forest service is organized, the property of the government; (2) That a permanent forest bureau be established; (3) That a commission be appointed to institute, under the supervision of the Director of the Geological Survey, topographical surveys of the reservations and determine what portions of them should be permanently reserved; and (4) to authorize the Secretary of the Interior to issue regulations for the protection of the reservations, for sales of timber, for entrance to the reservations, etc.

In *Science Progress* for April, Professor E. B. Poulton, of Oxford, prints, under the caption 'A Remarkable Anticipation of Modern Views of Evolution,' a note showing that Dr. James Cowles Pritchard, a distinguished pre-Darwinian anthropologist, anticipated by half a century the arguments urged by Weismann in favor of the non-transmission of acquired characters. This fact was brought to Professor Poulton's notice by Professor Mendola; and on consulting the work of Pritchard, entitled 'Researches into the Physical History of Mankind' (2d edition, 1826), Professor Poulton 'found that other important ideas are anticipated in it.' It throws an interesting side light not only upon the 'anticipation,' but also upon the attitude of Pritchard's mind toward the subject, that in a later edition of the work he cut out the passage. It is for this reason, Professor Poulton thinks, that the anticipation escaped the notice of 'Darwin and others,' who 'always went to the later edition.'

In an account of the work of the Lowell Observatory, for the last three months, published in the New York *Tribune* for April 17th, we are told: "Dr. Lee, who was in charge of the Observatory in the Southern heavens, announces that since January 1 more than three hundred thousand double and triple stars had been measured." Even for 'Dr. Lee,' from the vantage ground of an 'observatory in the Southern heavens,' this is doing finely—23 of them 'measured' per minute, day and night, more than half 'new,' as the *Tribune* tells us! We venture to suggest, however, that the *Tribune* is mistaken in stating that Sir John Herschel made larger additions to Southern stellar astronomy.' In his odd moments we are told that 'Dr. Lee' discovered 'many brilliant stars.' "In addition to these discoveries, his corroborative points of argument as to the formation of heavenly bodies will be exceptionally interesting—" the *Tribune* concludes.

A Reuter dispatch from Cape Town gives Dr. Koch's report on the rinderpest to the Secretary of the Agriculture Department, part of which is as follows: "I succeeded in immunizing within a fortnight several animals by means of a mixture of serum and virulent rinderpest blood to such a degree that they were enabled to withstand an injection of 20 ccm. of rinderpest blood, a ten-thousandth part of which is a fatal dose. From this fact I judge that the immunity of these animals is of a much higher degree, and I believe it is an active immunity equal to that of a beast which has contracted rinderpest and has then recovered. It is particularly important to know that only 20 ccm. of such serum are required to immunize one animal, and therefore one liter suffices for fifty head of cattle. A second and equally important fact is that one is able to render immune healthy cattle with the bile of such as have succumbed to rinderpest. In this case one hypodermic injection of 10 ccm. is sufficient. This immunity sets in on the tenth day at

the latest, and is of such an extent that even four weeks afterwards 40 ccm. of rinderpest blood could be injected without any injurious effect. I therefore conclude that the immunity produced in such a manner is of an 'active' nature. Rinderpest can be eradicated with but little difficulty and within a comparatively short time by putting these methods into practice. In infected parts nearly every case of rinderpest supplies a greater or less quantity of vaccine for those animals which are still healthy. I cannot but urge upon you the importance of bringing this method immediately to the notice of those cattle owners whose animals are suffering from or threatened by the disease." Dr. Koch offers to give a course of instruction at the experimental station at Kimberley.

DR. SCHLICH, C. I. E., professor of forestry at the Royal Indian Engineering College, Coopers-hill, read a paper at the Imperial Institute on Monday night on 'The Timber Supply of the British Empire.' Sir Stewart Colvin Bayley presided. According to the report in the London *Times* the lecturer said the average annual imports of timber into the several parts of the Empire during the years 1890–94 amounted to £19,135,000, while the exports averaged £5,114,000, showing that the net imports into the Empire reached the enormous sum of £14,021,000, an increase of £2,293,000 in six years, or a mean annual increase of £382,167. The United Kingdom was by far the greatest importing country within the Empire, having taken timber to the amount of £17,595,000 out of the total of £19,135,000. During 1894 the timber imported into Great Britain and Ireland from British colonies and dependencies was valued at £4,274,480, and foreign countries at £14,149,055. By far the larger portion of the timber imported into the United Kingdom came from Russia, Sweden, Norway, Germany, France and the United States, Canada being the only British dependency which at all equalled the export countries on the Baltic. Canada was estimated to contain 1,248,798 square miles of woodlands, but enormous tracts of that area did not contain any useful timber, while the remainder was by no means so well taken care of as it ought to be. Fires were frequent and disastrous, and the quantity of timber thus lost to the colony was calculated to be many times more than that cut down and exported. Notwithstanding those drawbacks, however, he believed that with proper management and careful conservation of the forests Canada might, at a moderate relative expenditure, supply the whole world for many years to come. He advocated the creation of a forest department in Great Britain, the careful conservation of existing and the creation of new forests by planting vacant lands, the establishment of schools of forestry, and model plantations for the guidance or private owners, and government grants in aid of those objects.

REUTER'S agent at Valparaiso, writing under date February 27th, gives particulars of Mr. Fitzgerald's expedition for the ascent of Aconcagua. The expedition of the Royal Geographical Society left Mendoza on December 7th last. There were, in addition to Mr. Fitzgerald himself, Mr. Vines, geologist; Mr. A. E. Lightbody, an engineer who joined the expedition at Mendoza; Mr. Philip Gosse, a naturalist, and Mr. Allan de Trafford, an engineer, with Mattias Zurbriggen, chief guide; Joseph Pollinger, second guide; Luis Pollinger and Lochmater, additional guides, and Zante Niccolo and Fritz Loribel, attendants. In order to climb Aconcagua they entered the valley of Horcones, where, at a height of 12,500 ft., a camp was pitched on January 7th. Another camp was established at a height of 14,000 ft., from which the actual ascent began. At the height of 18,000 ft. it was decided to plant on the side of Aconcagua the last camp. On January 15th Mr. Fitzgerald, accompanied by the chief guide, started for the summit, but at a height of 23,000 feet found himself unable to proceed. The guide went on alone, however, and on the afternoon of that day reached the highest summit of the mountain. Almost a month later, on February 13th, Mr. Vines also reached the top, after a journey of nine hours. Mr. Vines studied the geological structure of the mountain. The hillside, he said, is porphyritic and has a thick covering of argilaceous earth which cannot sustain vegetation. The south side is broken up into peaks. After the expedition

has made all the necessary observations of the formation of the mountain and the different heights, it will proceed to explore the mountain of Tupungato and also Mercedario, in the province of Coquimbo, which is nearly as high as Aconcagua.

UNIVERSITY AND EDUCATIONAL NEWS.

HARVARD UNIVERSITY receives $50,000 by the wills of the late Miss E. A. Haven and Miss C. M. Haven. Dartmouth College receives $15,000 from the same source, and Smith College $3,000 from Miss E. A. Haven.

MR. C. W. SPAULDING, lately Treasurer of the University of Illinois, is said to have used for his own purposes $400,000 in bonds and a large amount of money belonging to the University.

PRESIDENT DWIGHT, of Yale University, in his annual report recommends that the fiftieth anniversary of the Sheffield Scientific School, which occurs this year, be celebrated by suitable exercises. He states that a new building for the departments of physiology and morphology is needed and hopes that funds will be provided during the year. Gifts and bequests to the University during the last ten years have amounted to more than $4,000,000.

FROM the report of Cambridge University for 1896 it appears that during the year the University conferred 679 degrees of Bachelor of Arts, 33 of Bachelor of Law, 6 of Doctor of Science and 1 of Doctor of Letters. The total receipts of the University were upwards of £41,000.

WE stated recently that in nearly all cases the State universities had remained non-partisan. We must now record with regret the fact that the Populists, on securing a majority in the Board of Regents of the Kansas State Agricultural College, have dismissed a President who had served for eighteen years, to make room for a young man 'in harmony with the fundamental principles of the administration,' and have removed other members of the faculty and employees.

MR. JUNIUS MORGAN, a Princeton graduate resident in New York, who is known for his bibliographical collections, some of which he has recently contributed to the Princeton University library, has been appointed associate librarian in that institution. It may be added that the north stack room of the new library building at Princeton is nearing completion and the main collections are to be removed to it during the coming summer.

MR. W. B. MORTON has been appointed professor of natural philosophy in Queen's College, Belfast, filling the vacancy caused by the resignation of Dr. J. D. Everett.

PROFESSOR R. VON LENDENFELD, of Czernowitz, has been appointed professor of zoology in the German University at Prague. Dr. v. Below, of the Münster Academy, has been called to the chair of zoology at Marburg. Dr. Ludwig Heim has been appointed assistant professor of bacteriology. Dr. Gadamer has qualified as docent in pharmaceutical chemistry, at the University of Marburg.

DISCUSSION AND CORRESPONDENCE.

MR. LOWELL'S OBSERVATIONS OF MERCURY AND VENUS.

THE *Monthly Notices* of the Royal Astronomical Society for January, 1897, contains plates of drawings of Mercury and Venus, made by Mr. Lowell, at the Flagstaff Observatory, in 1896. The markings on Mercury were 'at once conspicuous' with the new twenty-four-inch object-glass; those on Venus are 'perfectly distinct and unmistakable.' The undersigned made a considerable number of observations of Mercury in the years 1873–1885, and a very large number of Venus in the years 1873–1890, with telescopes of six, sixteen, twenty-six, thirty-six inches in aperture, without ever once seeing markings of the character depicted by Mr. Lowell. Other markings of the class drawn by Schiaparelli and many other observers have, on the other hand, been seen and recorded whenever the conditions of vision were good. I have no hesitation in saying that such markings as are shown by Mr. Lowell did not exist on Venus before 1890. It is my opinion that they do not now exist on the planet, but that they

are illusions of some sort. Their general character* is what would be shown if the adjusting screws of an objective were set up too tightly, producing a set of strains in the glass, or if the objective were strained by its cell. Strains of this sort will sometimes produce faint companions to stars sufficiently bright. A comparison of all the drawings of Venus available in the library of the Lick Observatory is very instructive. All observers, except those at Flagstaff, see faint markings of one class, while those drawn by Mr. Lowell are of a totally different nature.

Venus has been observed on very many occasions at Mt. Hamilton, with our essentially perfect twelve-inch object-glass, in the years 1888–1897, without once seeing markings of the kind drawn by Mr. Lowell, or 'distinct' markings of any kind. Faint and indistinct markings, of the character of those drawn by scores of observers for a century past, are, however, seen when the circumstances are good.

The foregoing notes seem to me to throw doubt on the reality of the markings reported from the Flagstaff Observatory. Until Mr. Lowell's observations are fully comfirmed by other observers with other telescopes, it will be wise not to accept them unreservedly.

EDWARD S. HOLDEN.

MT. HAMILTON, March 9, 1897.

*Six or more radial rays, thicker at the outer rim of the image of the planet.

FURTHER CONSIDERATIONS ON THE SYSTEMATIC POSITION OF TARSIUS.

PROFESSOR HUBRECHT has replied with some warmth to the paper I lately published in SCIENCE, in which I attempted to show that, in my opinion, *Tarsius* is more of a lemur than an ape, although in reality an annectant type between the two. The objection I raised to placing *Tarsius* among the apes and the effect of this transferral on the classification of the Primates based on their osteology related to recent forms. Professor Hubrecht is probably quite aware that, when we introduce the fossil Primates into the question of classifying the recent forms, the apparently sharp lines of demarcation between the skeletons of recent lemurs and apes disappear.

I entirely agree with Professor Hubrecht in the idea that classification should be based as far as possible on phylogeny, and that the only truly scientific arrangement of animals depends upon a knowledge of their whole organization, both embryonic and adult. I claim, however, that the paleontological method in determining phylogeny is more nearly accurate than the embryological, as in the latter many characters are lost and innumerable cænogenetic variations are introduced which the embryologists often cannot distinguish from real homogenetic structures. The great number of phylogenetic trees based on embryology which are annually cut down is amazing, and in fact the truth of the theory of recapitulation as applied to the embryonic stages is now somewhat questioned.

I do not at all regret quoting the name of Francis Maitland Balfour in regard to his warning against placing too much reliance on placental arrangements as criteria for the classification of the Mammalia, and hold that it applies directly to the question of the systematic position of *Tarsius*. On this side of the Atlantic we do not all follow the Neo-Darwinians in believing that the germinal products are locked up in iron safes as it were, and not affected by external conditions as the rest of the organism.

I will now sum up my principal reasons for not accepting Professor Hubrecht's views that *Tarsius* is only related among the Primates to the Anthropoids:

1. It has not been shown as yet that the placenta in the lemurs is not a derivative of the chorion as in the apes.*

*M. A. Milne-Edwards remarks: "Or, l'allantoide des Indrisines est si facile à detacher des parties adjacentes, qu'il me semble peu probable qu'il ait laissé un de ses feuillets adhérent au chorion, et il y a tout lieu de penser que l'explication mécanique de la production du placenta, telle qu'elle a été proposée par M. Baer et Bischoff n'est pas toujours l'expression de la vérité, et que, dans certain cas au moins, l'arrivée des vaisseaux sanguins de l'allantoïde à la face externe du chorion provoque une hypertrophie dans les parties correspondantes du tissu de cette enveloppe fœtal, et que c'est de cette manière que se forme le placenta, et non à la suite de l'accolement d'une portion des parois de la vesicule allantoïdienne." Mammiferes de Madagascar, p. 284.

2. The diffuse stage of the placenta of some of the anthropoids is apparently directly comparable to that of the lemurs.

3. There is no fundamental distinction between a large free allantois and one which is rudimentary; it is merely a matter of degree and not one of kind.

4. There is no paleontological evidence as yet deduced which proves that apes and lemurs have arisen independently and that these two phyla were distinct as early as the Mesozoic.

5. The Santa Cruz beds of Patagonia in which *Homunculus* occurs are probably as late as the Lower Miocene.

6. *Anaptomorphus* of the Lower Eocene is much more closely related to the lemurs than to the apes, but it has certain anthropoid characters which indicate that some of the latter may have been derived from this genus.

7. Our present paleontological knowledge indicates that the Old World apes have been derived from a lemurine stock as late as the Oligocene.

8. Synthetic types as *Adapis*, *Tarsius* and *Mesopithecus* demonstrate that apes and lemurs are genetically related.

It remains to be seen whether naturalists in general will be willing to accept Professor Hubrecht's views as to the systematic position of *Tarsius*, depending upon the connection of placenta with the embryo (bauchstiel) and also on the histological details of the former. It seems probable that in forming an opinion as to the affinities of any animal the only judicious course to pursue is to consider the whole organization as well as the development. As far as I can learn from Professor Hubrecht's paper he has not followed this method, but wishes us to accept his conclusions hardly referring to the structures of *Tarsius* which are identical with those of the lemurs and which occur in no other mammalian group except the lemurs.

In conclusion I would like to call Professor Hubrecht's attention to the following passage from Burmeister's Monograph, which shows that he considered *Tarsius* to be a lemur, although Professor Hubrecht does not mention this fact in his memoir: "Aber Tarsius ist nicht mal ein Affe, er ist vielmehr nur ein Halbaffe, ein Mitglied jener Gruppe * * * * *; Darin unterscheidet er sich von allen übrigen Halbaffen und steht eben desshalb so isolirt unter ihnen da." It would be of interest if other morphologists would enter into this discussion and give their opinions as to the systematic position of *Tarsius*. If I did not state Professor Hubrecht's case thoroughly it was an oversight on my part.

Charles Earle.

New Rochelle, New York, April 7, 1897.

THE COMING ICE AGE.

To the Editor of Science: In Science of March 19th Professor G. Frederick Wright, in his notice of the Coming Ice Age, says that "he is not sure that he has comprehended the author's meaning." And it seems that such is the case where he writes that "the theory of the author is that a land conection between Patagonia and the Antarctic Continent, or a great diminution of the channel between these lands, would produce an effect upon the ocean currents favorable to the glaciation of both hemispheres." This description is so inadequate that it may produce a wrong impression, and so prevent a clear apprehension of what follows in the review. One of the main objects of my explanations has been to show that the closing or diminution of the channel south of Cape Horn would cause the tropical currents to enter the southern seas in sufficient volume to cause an age of mildness in the high southern latitudes which would spread over the globe, and the warm climate would continue until the southern oceans through a slow process retained water sufficient to greatly enlarge the channel south of Cape Horn, and so cause conditions favorable for the glaciation of lands situated in the high southern latitudes, such as is being performed to-day. Consequently, my prognostication of a coming ice age is based on the present enlarged condition of the Cape Horn channel, which affords sufficient space for the strong prevailing westerly winds of that latitude to force the surface waters of the southern oceans through the wide channel and so onward around the globe. Therefore, the

tropical surface currents setting southward are largely turned away from the antarctic regions, so only a scanty portion of the water from such currents reach the frigid latitudes. And through this cause the antarctic lands have become heavily glaciated, and the glaciers are constantly flowing into the sea. This process chills the waters surrounding the antarctic shores and causes them to sink and find their way to the temperate and tropical latitudes in under currents. In this way all of the under-waters of the oceans have acquired a low temperature, and there is much to show that their coldness is being slowly increased, and in consequence a cold epoch is being brought about. There is nothing hypothetical concerning the vast operations of nature which give support to this view of the subject. For it is well known to the navigators of the southern oceans that the belt of strong westerly winds which sweeps the southern seas causes a cold drift current to move around the Antarctic Continent. And it is also well known to science that the chilly waters of the antarctic seas find their way to the temperate and tropical latitudes in cold under-currents.

C. A. M. TABER.

THE SMITHSONIAN TABLE AT THE NAPLES STATION.

IN view of the necessary delay in connection with several applications which have recently been made for the use of the Smithsonian Table at the Naples Station, it may be well to call the attention of zoologists and botanists to the 'Report on the Memorial presented to the Smithsonian Institution regarding an American Table at the Naples Zoological Station,' printed in SCIENCE, XXI., No. 641, June 16, 1893, pp. 328–329.

Candidates will avoid delay in the consideration of their applications if they will bear in mind the following suggestions:

1. Applications should be addressed to Professor S. P. Langley, Secretary of the Smithsonian Institution, Washington, D. C., and *not* to the Secretary of the Advisory Committee.

2. The candidate should state his entire educational history, give a list of the papers he has published, and if possible send reprints of the same to accompany his application.

3. He should apply for a definite period of time, not exceeding six months, and state the time of year which will be most convenient for him to occupy the table.

4. He should give some definite statement as to the general line of investigation he wishes to pursue while at Naples.

5. If a recent graduate and a person not thoroughly known as an author, he should request his former instructors to write in his behalf to the Secretary of the Smithsonian Institution.

If the professors of zoology and botany in the various universities will bear these suggestions in mind they will greatly lessen the correspondence and delay in connection with the consideration of the applications from their students and will at the same time forward the interests of the applicants.

CH. WARDELL STILES,
Secretary Advisory Committee.

SCIENTIFIC LITERATURE.

An Introduction to Geology. By WILLIAM B. SCOTT. The Macmillan Co. 1897.

The author of this class-book has attempted, and we think successfully, to provide a brief but complete and sufficiently detailed treatment of geology for the ordinary college student.

He has used as a basis the fuller standard treatises on Geology, has taken as his model Sir Archibald Geikie's 'Class-book;' has written it for American students, selecting examples from American geology; has illustrated the work with reproduced scenes taken by American geologists, and has had help and suggestions from other workers in special fields. The result is, in general, a satisfactory book to put in the hands of a class of students, and particularly well adapted, as it seems to the writer, to supplement a course of lectures in a general college curriculum.

The arrangement of the chapters is not altogether such as a teacher would naturally use, and that some license is given to readjust the chapters is suggested by the remark in the preface: "The order in which the different sections of the book are taken up should depend somewhat upon the season of the year in

which the study is begun." The chapters themselves, however, treat of the subjects with precision and sufficient detail for the production of definite notions on the points discussed.

The treatment of Historical Geology is on the lines of Dana's Manual, but without the details. This method in an exhaustive manual is valuable, but it may be doubted whether the use of so many scientific names of animals and plants as is necessary in such a treatment conveys any definite information to readers who are unfamiliar with zoology and botany; and even to zoologists, unless very well acquainted with the paleontological side of their science. The fact is that a really satisfactory mode of treatment of this fascinating subject of the biological problems of historical geology has not yet come to light.

The illustrations are, in the main, excellent and new and, as has been said, richly American. But some of them are so imperfectly reproduced from the original photographs as to lose much of their value.

The publishers' part of the work is well done, though the user of the book will often be caused to lament that it is found necessary to put so much weight into a book one is expected to hold in a single hand.

H. S. Williams.

Yale University.

The Glaciers of North America. By Israel C. Russell, Professor of Geology in the University of Michigan. Boston, Ginn & Co. Pp. x+210.

When the glaciers of Switzerland had been well explored those in this country were scarcely known, and now Professor Russell tells us that North America is the best region in the world for the study of glaciers; that all types occur here, of all sizes and in great variety; and he makes good his assertion by the descriptions of the glaciers of North America, so far as they are now known, which fill the greater part of the volume before us.

Professor Russell attacks his subject as a geographer; his aim is to report the present condition of knowledge concerning the glaciers of this country and to 'stimulate a thirst for fresh explorations and renewed study along an almost untrodden path.'

To carry out this object the book must necessarily be largely a compilation, but the material for an important part is furnished by the original papers of the author himself. Of these we mention especially the account of the Mt. St. Elias region, which Professor Russell explored in the course of two remarkably plucky attempts to ascend Mt. St. Elias.

He opens with a chapter giving a clear account of the characteristics of glaciers and their work, in the course of which he is confronted with the question: 'What is a glacier?'

A concise definition of a class of natural objects is always difficult; and certainly none has yet been given which includes all the phenomena of glaciers. Mr. Russell recognizes this and gives provisionally the following definition: A glacier is an ice body originating from the condensation of snow in regions where secular accumulation exceeds melting and evaporation, *i. e.*, above the snow line, and flowing to regions where waste exceeds supply, *i. e.*, below the snow line.

The majority of geologists and physicists would accept this as fairly representing the essential characteristics of a glacier; but the small number who believe that the force urging a glacier down its bed is not due to gravity alone, but to a large extent to the increase of the volume of the ice on account of the growth of the ice grains, must utterly reject it; for, according to their hypothesis, the source of supply is not snow that falls in the névé-fields, but the water that freezes throughout the body of the glacier.

The glaciers of North America are confined to the Cordilleran mountain series and to the Greenland region. Professor Russell says that "the Cordilleran glaciers form an irregular curve, broadest and reaching the sea line in the Mt. St. Elias region, and narrowing and becoming more and more elevated at both its western and southern extremities," and then he successively describes in greater detail the glaciers of the Sierra Nevada; of the Cascade range, the higher peaks of which are volcanic cones and carry glaciers radiating from their summits; of Canada, and of Alaska. The

latter, of course, claim the greatest attention, on account of their number, size and variety. Here are the most accessible tide-water glaciers, and many tourists have already seen the birth of icebergs at the end of Muir glacier. Here also is the great Malaspina glacier, a mass of ice formed by the coalescence of the ends of many glaciers descending from the St. Elias Alps. It lies on a flat expanse between the mountains and the ocean and covers an area of some 1,500 square miles. Professor Russell has crossed this glacier along several lines and practically all we know of it is due to his explorations. It is the only Piedmont glacier that has been visited.

The absence of glaciers in the central and northern parts of Alaska is explained as due to insufficient precipitation; but in these regions we find the strange subsoil ice whose thickness has not been determined, but which in places certainly extends several hundred feet below the surface of the soil.

The glaciers in the northeastern part of the continent occur both in Grinnell Land and Greenland. Some of the former have been visited and described, but have not received much attention, whereas the latter have attracted quite a number of observers. The recent studies of Professor Chamberlin first made us familiar with certain remarkable characteristics of these glaciers which are not found in regions further south.

In the chapter on Climatic Changes, Professor Russell shows that the glaciers of North America, with a few exceptions, are growing smaller; and he mentions the efforts being made by the International Committee on Glaciers to collect information on the variations of glaciers everywhere.

In telling of 'How and Why Glaciers move,' the observations of Kock and Klocke are narrated. These observers thought they had detected certain irregularities in the motion of the Moteratsch glacier, parts of the ice moving at times up the valley. Professor Russell is cautious in accepting such an anomaly, and indeed the observers themselves have since recognized that these irregularities were within the limit of the errors of observation.

The hypotheses which have been advanced to account for the apparent plastic flow of ice, notwithstanding its great brittleness, are well given and well criticised, especially from the point of view of the geographer; though James Thomson's theory is too shortly dismissed, and Croll's hypothesis receives more attention than it deserves, for it is radically wrong. The growth of the glacier grains, as a cause of motion, has been advanced from time to time, but has not been sustained; Forel developed this hypothesis into a theory, but found later that it was not supported by his observations.

Professor Russell believes that the motion of glaciers is due principally to the plastic flow of ice under its own weight, but that many other causes play a minor part; some of these a physicist would throw out entirely.

The book closes with a very interesting chapter on 'The Life History of a Glacier.' This is an extension of Professor Davis' topographical cycle to the history of a glacier, and is an entirely new addition to glacial literature.

A slip is made on page 181 in saying that the heat absorbed when ice melts equals the heat necessary to raise the water thus formed from its freezing to its boiling point, and §11, p. 187 is misleading; exception might also be taken to the statement (p. 192) that in a vertical section through the névé-fields the maximum flow [velocity] would probably be near the bottom.

This book may be heartily commended to the general reader, and will be of great help to the student of glaciers. It is illustrated by a number of well-selected pictures and maps, and important references are given in foot-notes.

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Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, herausgegeben von PROF. DR. G. HELLMANN.

No. 7. *Esperienza dell'Argento Vivo.* EVANGELISTA TORRICELLI. *Istrumenti per conoscer l'Alterazioni dell' Aria.* ACCADEMIA DEL CIMENTO. 4to. Pp. 22, 16.

No. 8. *Meteorologische Karten.* E. HALLEY, A. VON HUMBOLDT, E. LOOMIS, U. J. LE VERRIER, E. RENOU. 1688, 1817, 1846, 1863, 1864. 4to. Pp. 13. Charts 6.

No. 9. *A Discourse Mathematicall on the Variation of the Magneticall Needle.* Henry Gellibrand. London, 1635. 4to. Pp. 7, 24. Fascimiledrucke, mit Einleitungen. Berlin. A. Asher & Co., 1897.

Three new numbers in Dr. Hellmann's notable series of *Neudrucke* are before us, each number being of great interest and value. Dr. Hellmann certainly deserves, and we do not doubt will receive, the thanks of all men of science for the pains he is taking in preparing this set of publications. No. 7 contains reprints of the letters which passed between Torricelli and Ricci concerning the measurement of atmospheric pressure, and of the description of the thermometer and hygrometer, prepared and published by the Accademia del Cimento. The letters of Torricelli are of very great scientific interest, for they concern the famous experiment, which was carried out by Viviani in Florence in 1643, at the suggestion of Torricelli. The latter left no written statements regarding the barometer, but he sent word of his discovery to his friend Ricci, in Rome, and his two letters, most fortunately preserved, are reprinted in the present volume. They bear dates June 11 and 28, 1644, and show clearly that Torricelli knew that the mercury in the tube changed its height according to the conditions of the surrounding atmosphere, rising or falling as the air became heavier or lighter, and that he made the experiment in order that he might have an instrument for observing atmospheric changes. The report of the Accademia del Cimento concerns the early history of temperature and humidity observations. This reprint, which is a facsimile, gives two chapters of a celebrated work by Lorenzo Magalotti, Secretary of the Academy, entitled '*Saggi di naturali esperienze fatte nell'Accademia del Cimento*' (1667), in which the most important results of the experiments made by the Academy were set forth. These chapters deal with thermometers and hygrometers, and facsimiles of the original drawings of some of these instruments are given.

No. 8 of the *Neudrucke* gives reproductions of six meteorological charts, the original publication of which was in each case epoch-making. The first is the wind chart of Halley (1686), the oldest of all meteorological charts; the second, Humboldt's isothermal chart, 1817, the first one on which isotherms were given; the third is a reproduction of one of the 13 synoptic weather maps published by Loomis in 1846, the fourth and fifth charts are facsimiles of those issued by Le Verrier in September, 1863. These were the first daily weather maps with isobars, based on data sent by telegraph. The sixth chart is a reproduction of one by Renou in 1864, which was the first to give the mean isobars for any country. This gives the mean isobars of France.

No. 9 is a facsimile reprint of a very rare paper by Gellibrand (1635), which contains the first account of the discovery of the secular variation of magnetic declination.

All these reprints, like those which have preceded, contain copious notes by Dr. Hellmann, in addition to the introduction. The series is one which should be in every scientific library.

R. DeC. Ward.
Harvard University.

Biologia Centrali-Americana. Archæology. The Archaic Maya Inscriptions. By J. T. Goodman. London, R. H. Porter. 1897. 4to. Illustrated. Price, $13.50.

One of the early Spanish missionaries warns his readers against studying the native Mexican calendar system, since it is an invention of the devil and liable to disturb the faith and cloud the reason of those who seek to understand it.

It is a pity that this warning has not been heeded in the present generation by a certain class of writers, as we should then have been spared a rather extensive series of works characterized by a plentiful lack of sound knowledge and an abundance of wild speculation; among them the bulky quarto (which the author fancifully calls 'a little book'!), the title of which is given above.

It is the result, he tells us, of twelve years' labor; but when it was tendered to the California Academy of Sciences that learned body 'could not see its way' to printing the book (prudent Academy!). Mr. Maudslay, however, whose explorations have been so valuable, but who does not pretend to interpret the inscrip-

tions, was impressed by the author's claims and secured its publication in London.

That it should appear as one of the series of the 'Biologia Centrali-Americana' will give it a position liable to credit it to the intelligent public as a scientific work. This it is not in any sense, and no one can be more positive on this point than the author himself. He loses no opportunity to berate all who have attempted to apply scientific methods to the study of the Mayan inscriptions and the ancient calendars. They are 'shoe-string scientists,' 'dilletanti,' 'assumed authorities,' engaged in 'pompous kowtowing to each other.' He, the author, Mr. J. T. Goodman, announces himself as the 'illiterate proletaire' who is to 'push them rudely from their seats.' Like Walt Whitman, he 'flings his barbaric yawp over the roofs of the world.' That was fine in Whitman, but he was a poet; though Mr. Goodman can claim considerable imagination also.

Needless to add that his pages show no trace of this despised learning. The names of such European scholars as Seler, Förstemann, Rosny, do not once appear. This we may excuse, as Mr. Goodman doubtless extends his contempt to a knowledge of French and German; but one would suppose that the interesting computations of Dr. Cyrus Thomas, published by the Bureau of Ethnology, would have been vouchsafed a word. But they are not once mentioned.

He does not consider any knowledge of the Maya language necessary in order to read the inscriptions, nor an acquaintance with the mythology or culture of the tribe, nor an investigation into the origin of the glyphs. All this is beside the mark. To him, each glyph, each face or figure, each day or month sign, is a numeral, simple or complex. He ascertains their meanings by a 'sort of intuition' (p. 78); he 'arrives at a conviction' (p. 144); he has no doubt of his results, though they obstinately 'evade proof' (p. 97); but at any rate he is willing to bet considerable on their accuracy (p. 33); and this certainly ought to be sufficient for anybody except some stupid scientific reader!

Occasionally he betrays a slight but regrettable distrust of this original and excellent method. He acknowledges that this opinion is 'little more than an assumption,' or that identification insufficiently established; but his faith is not in the least shaken that time and the future big volumes he has in view will demonstrate all his positions to the satisfaction of everybody, excepting always 'the incompetent few' (p. v.), by which polite reference he means his *bêtes noirs*, the scientific students of the subject.

His main thesis is that, 'with the exception of the priests and their assistants, all the personages of the codices and inscriptions, ornaments and accessories, are composed of numeral signs' (p. 85). In illustration, he portrays the head of the 'long-nosed god,' so frequent in the Dresden Codex, and finds a numeric value in each of its elements, in the eye, the ear ring, the head dress, and even in the celebrated nose itself, which we learn stands for 13. This has been equalled in Mayan research only by the late Dr. Cresson, who dissected in a similar manner the glyphs and figures, but who found, not numbers, but phonetic elements, in each curve and crook of the work of the aboriginal artist.

The crown and completion of Mayan numeration Mr. Goodman discovers in the bird which surmounts the cross in the well-known tablet at Palenque. This is the sign of the 'grand era' of the Mayas, which he figures out to be 374,400 years. He has not fully dissected the bird, and is not quite prepared to assign the arithmetical value of each of its legs, etc.; but that is merely because he has 'not found time' for it (p. 84); and this does not in the least disturb his 'belief.'

To one unprepared by twelve years of study of hieroglyphs it is at first a little choking to swallow such a large antiquity for the Mayan culture; but Mr. Goodman wisely warns us that, in view of his researches, "we shall have to let out the strap that confines our notion of history," and acquire a 'wider mental range' than we have hitherto enjoyed (p. 149). To go back ten thousand years in the history of the happy Mayan people is to him but a trifle.

It is rather difficult to take this big volume seriously. Even the formidable tables which fill its last hundred pages fail to dispel the feel-

ing of amusement created by the author's curious notions and chosen 'wild and wooly' style, on which latter he especially plumes himself. Only, it is out of place in the 'Biologia.' It should have been issued by Bret Harte's scientific society 'on the Stanislaw,' and reported upon by 'Truthful James.'

Nor, in the hundreds of guesses of the author, has he failed of some worth passing reflection. His theory of the correction for the bissextile year is at least suggestive. His explanation of the *ua katun;* his comments on the Cakchiquel calendar; his reasons for dismissing the cypher in Mayan numeration; his argument that the ancient system of computation was to the end of a period instead of the beginning of a new one—these and some other thoughts may be rescued from the mass of crude assertions as meriting separate consideration. But, as a whole, the conviction will be forced on the enlightened reader that the cause of American archæology has gained practically nothing, and has lost something, by the publication of this heavy tome.

D. G. Brinton.
University of Pennsylvania.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, APRIL.

On the Butanes and Octanes in American Petroeum: By Chas. F. Mabery and Edward J. Hudson. The authors have studied the very volatile portions of petroleum, obtained by distilling the crude product during the cold winter months, the distillation in some cases proceeding from the heart of the atmosphere and being regulated by cooling the still. In order to identify the different hydrocarbons formed they were converted into their chlorine substitution products by bringing the vapor of the hydrocarbon together with chlorine. The distillations were carried out with great care and ingenuity and a number of derivations of butane were made and studied. The results showed that the petroleum contained no normal butane, but isobutane. In isolating the octane the authors found that a long series of distillations had to be carried on to obtain pure products. They state that these octanes do not begin to accumulate with any degree of purity until the twentieth distillation. They obtain an octane which they studied and also showed that the petroleum contained no octane boiling above 125°.

Naphthalene Tetrabromide: By W. R. Orndorff and C. B. Moyer. Naphthalene tetrachloride has been studied by a number of chemists, but the corresponding bromine compound had not been prepared until the authors of this paper undertook its investigation. They found it could be prepared by treating naphthalene, in sodium hydroxide, with bromine. Cracked ice was put in the flask and also around it to prevent any decomposition taking place from the heat developed. A white cystalline substance was obtained which melted at 111° C. The cystallography of this substance was studied, the angles measured and the more common forms drawn. Many attempts were made to obtain an isomeric substance, but they all failed. The molecular weight could not be determined by the boiling-point method, but some rough determinations of the molecular weight of the tetrachloride were made and the composition of the bromide deduced from this by analogy. By this method and by analysis the composition was shown to be $C_{10}H_8Br_4$.

On Hydrocobaltocobalticyanic Acid and Its Salts: By C. Loring Jackson and A. M. Comey. This work was undertaken in the hope of preparing, from potassium cobalticyanide, compounds analogous to the nitroprussides. When this compound was boiled for some time with strong nitric acid a gelatinous substance was formed, which was found to contain all the cobalt and to have the composition $KH_2CO_2(CN)_{11}H_2O$. This is the monopotassium salt of hydrocobaltocobalticyanic acid. The barium, silver, copper and zinc salts of the acid were also prepared. When the monopotassium salt was treated with potassium hydroxide cobaltic hydrate was precipitated and a substance was isolated from the filtrate which proved to be potassium cobalticyanide. The fact that the substance crystallized in needles instead of in broad, rhombic crystals was probably due to a slight amount of impurity. While some of the properties of these substances are similar to those of the ferrocyanides and ferri-

cyanides, they are not such as would aid speculation on the nature of their salts.

On the Analogies in Composition of the Salts of Calcium, Strontium and Barium: By J. H. KASTLE. The author calls attention to the strong analogies which exist between the calcium, barium and strontium salts. According to the views of Lenssen strontium and barium show greater analogies, in the composition of their salts, to one another than they do to calcium. In this paper the author cites a large number of salts, and concludes from a study of their composition that the analogy and composition of the calcium, barium and strontium salts of any given acid is just as likely to show itself between the salts of all three of these metals, or between the calcium and strontium salts of that acid, as it is between the calcium and barium salts, or those of strontium and barium, and *vice versa;* or that, so far as composition of their salts is concerned, these three metals are altogether similar.

Action of Mercaptides on Quinones: By H. S. GRINDLEY and J. L. SAMMIS. This article contains a preliminary notice of an investigation being carried on by the authors, on the action of mercaptides or substituted quinones. They have obtained a product, by the action of sodium mercaptide on dichlor-diphenoxyquinone, which is very unstable and decomposes in the presence of water, forming tetrathioethylquinone. Some of the derivatives of this substance were also prepared and studied.

The Action of Sodium Ethylate on Amide Bromides: By S. E. SWARTZ. It has been shown that amines can be formed from acid amide bromides by treatment with caustic alkali, and that the peculiar rearrangement which takes place in the molecule is perfectly analogous to the so-called Beckmann's rearrangement of ketoximes. These changes take place in alcoholic solutions, and it was suggested that, perhaps, if the substances were brought together in some solvent which would not produce electrolytic dissociation, the rearrangement might be prevented and direct substitution effected. It was found that succinimide bromide, treated with dry sodium methylate, regenerated succinimide, that no rearrangement took place, and that at the same time bromine was not replaced by the methoxy group. When the reaction was carried out in alcoholic solution in every case rearrangement was effected. A number of amide bromides were decomposed in this way, and in every case the action took place as described above. One of the products, phenyl urethane, was treated with phosphorus pentachloride and chloroformanilide and phenyl isocyanate were obtained. As these compounds had been studied very little, a number of their derivatives were prepared and studied.

The Hydrolysis of Acid Amides: By IRA REMSEN. The author calls attention to the changes produced by the action of dilute acids on acid amides. It has been shown by him, in the course of an investigation on the oxidation of substitution products of aromatic hydrocarbons, that when chromic acid is used, an oxidizable residue, situated in the ortho position with reference to a group that is not oxidizable, is almost completely protected from oxidation, while similar groups in the meta or para position are easily oxidized. An investigation is now being carried out which, up to the present, shows that the ortho amide resists the action of the hydrolysing agent to a marked degree, while the meta and para amides yield readily, the latter more so than the meta. The investigation will be extended to other amides to see if they will conduct themselves in the same way.

A review of Lehrbuch der allgemeinen Chemie, W. Ostwald; Zweiten Bandes, zweiter Teil; is also contained in this number of the *Journal.*

J. ELLIOTT GILPIN.

TERRESTRIAL MAGNETISM, MARCH, 1897.

WITH the present number, this journal, devoted to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras and Atmospheric Electricity, enters on its second volume. The editor, Dr. L. A. Bauer, having been appointed assistant professor at the University of Cincinnati, the office of publication has been transferred to that institution. The contents of the present number are:

The Effect of Hardness on the Electrical and Magnetic Constants of Steel, with Particular Reference to the Tempering of the Magnetic Parts of Instruments, Carl Barus; Vertical Earth-Air Electric Currents,

L. A. Bauer; Magnetic Work at the Kew Observatory, Charles Chree; On the Distribution of Magnetic Observatories over the Globe, Adolf Schmidt; Results of Magnetic Observations on the Greenland Expedition of 1896, G. R. Putnam; Letter to Editor: A Proposal with Regard to an International Magnetic Congress, A. Schuster.

Professor Barus, in his article, gives a valuable summary of the results obtained in the tempering of magnetic needles, by Dr. Strouhal and himself, some years ago. The article, which is illustrated, closes with rules for the practical treatment of magnets, where great secular permanence of magnetization is the principal desideratum.

Dr. Bauer investigates the matter of electric currents passing from the air into the earth or from the earth into the air. If such currents exist, their presence will be indicated by the non-vanishing of the line integral of the earth's magnetic force, resolved along a closed curve of the earth's surface. The author selects, as his closed circuits, parallels of latitude between 60° N and 60° S and distant by 5° from each other. He bases his investigations on the Neumeyer magnetic maps of 1885. The result of the investigation would seem to be that, apparently, an appreciable part of the earth's total magnetism can be referred to an effect similar to that of vertical electric currents. The average intensity of these currents for the region between 60 N and 60 S would be about one-tenth of an ampere per square kilometer of surface.

Dr. Chree gives an interesting account of the work done at Kew Observatory, of which he is Superintendent. Dr. Schmidt finds that the present distribution of magnetic observatories, the great majority being on European ground, is far from satisfying the demands of modern science. In order to establish some criterion with regard to the precision to be obtained in the results of a geomagnetic investigation as based upon the present observatories, he undertakes a mathematical examination, making various combinations of existing observatories and proposed ones. It is remarkable how much the addition of one or two observatories in the southern hemisphere will reduce the probable error in the coefficients of the spherical harmonic series representing the phenomenon under consideration. New observatories are, above all, needed in the southern part of South America, the central Pacific and in New Zealand.

Mr. Putnam summarizes his recent magnetic work in Greenland. Professor Schuster proposes that an International Magnetic Congress of all those interested in the subject be held in 1899.

THE AMERICAN PHYSICAL EDUCATIONAL REVIEW.*

THE American Association for the Advancement of Physical Education has made a new departure in the line of publication. This Association has been in existence since 1885 and has published ten reports containing papers given at the annual meetings. These reports have been increasing in size and value and constitute the best literature of physical education in English.

In the reorganization of the Association, which took place a year and a-half ago, the annual meetings ceased, to give place to triennial or quadrennial conventions. The effort is now being directed to the formation of local physical education societies and of State branches, making it possible for the teachers to have sections in connection with the County and State Teachers' Associations. Twelve local organizations have already sprung up and are exhibiting signs of considerable activity in their monthly and annual meetings.

The interests of the National Association are in the hands of a Council of nine members, who act as an executive committee in all matters relating to the Association's interest. The National Council, after publishing the Tenth Annual Report, which fell to their lot at the close of 1895, have undertaken, instead of such annual reports, the publication of the *American Physical Educational Review*, the first volume of which has just appeared. It is proposed during 1897 to publish four numbers consisting of about 60 pages each, to contain original articles relating to physical education, reprints of articles not easily accessible to members of

* Published quarterly under the auspices of the American Association for the Advancement of Physical Education. Edited by E. M. Hartwell, G. W. Fitz, R. G. Huling. Cambridge, 1896.

the Association, reviews of related literature, etc.

The first volume consists of the following original and reprinted papers:

'Peter Henry Ling, the Swedish Gymnasiarch,' by E. M. Hartwell; 'The Olympic Games and Their Influence upon Physical Education,' by Ellery G. Clark; 'Statistical Sketch of the Present Status of Physical Training,' by Karl Zapp; 'What the City of Braunschweig, Germany, Does for the Physical Training of her Children,' by Ernst Hermann; 'Report of Committee of the Boston Physical Education Society, to Suggest a Substitute for the Manual of Arms as a Means of Physical Exercise in the Military Training of School-boys;' 'Military Drill in the Public Schools,' by D. A. Sargent; 'Manual Training: Its Educational Value,' by Thomas M. Balliet; 'The Influence of Exercise upon Growth,' by Henry G. Beyer; Brookline Public Bath; Reports from Societies; Editorial Notes and Comment; Book Notices and Bibliography; 'Index to the Ten Reports of the A. A. A. P. E.,' by J. M. Pierce.

One of the most important contributions to this number is the Index to the ten reports of the A. A. A. P. E. prepared by Mr. John M. Pierce. The National Council have decided to strike this off as a reprint for the benefit of those who desire to bind it with the reports. The report of the Committee on Military Training has also been reprinted and should do good educational service in combating the misguided efforts in different parts of the country to foist military drill on the public schools in place of a rational system of sports, games and physical exercises. Copies of both these reprints may be obtained by application to the Corresponding Secretary, Dr. G. W. Fitz, Cambridge, Mass.

The Council of the A. A. A. P. E. are to be commended for their boldness in undertaking this publication, and to be congratulated on its creditable appearance. Teachers in general will feel indebted to them for making accessible valuable papers on physical education, especially since the low price of membership, one dollar per year, brings the *Review* easily within their reach. G. W. F.

HARVARD UNIVERSITY.

SOCIETIES AND ACADEMIES.

SCIENTIFIC ASSOCIATION OF THE JOHNS HOPKINS UNIVERSITY.

THE one hundred and thirty-second regular meeting was held March 18, 1897, President Remsen in the chair.

The papers presented and read were:

1. 'The Projection of Panoramic Views of Contoured Surfaces,' by Josiah Pierce, Jr.

The principal subjects brought up for discussion were: 1. The metrical and projective properties of contours and bas-reliefs. 2. The principles involved in the projection of irregular plane-figures and surfaces. 3. The practical applications of the laws of projection in the design of perspectographs and mechanical aids to projection.

It was demonstrated in the paper that the general problem of the projection of an irregular surface of any form could be reduced to one of great simplicity by the methods suggested by the author of projecting successive contours or equidistant sections of the surface. The methods were shown to be applicable to the illustration of complex geological problems, which under ordinary conditions would require to be illustrated upon models, and for the solution of many difficult problems in projection, such as the determination of shadows on irregular surfaces and the development of bas-reliefs and projective forms.

Illustrations were given of a number of practical applications of the methods by drawings of very irregular surfaces developed in relief by the projection of contours—such as panoramic views of wide areas, and surfaces developed in high or low relief under different conditions of projection from horizontal vertical and inclined sections.

In the discussion given of the general problem of the projection of irregular plane figures two methods of operation were presented—one involving the metrical and projective relations of corresponding points of plain figures in perspective, applicable in the design of perspectographs and linkages; the other the relations of corresponding lines in perspective—applicable in the methods of tracing the projections of irregular figures—enclosed in nets of intersecting lines.

. It was shown to be possible to perform any operation of plane perspective with a sliding linkage of three rods and by a slight modification of the pantagraph to obtain any desired orthogonal or parallel projection of an irregular figure or surface.

The author also called attention to the extreme simplicity of the methods of projecting extensive panoramic views from contoured maps by the employment of a linkage of two threads, the methods being fully illustrated by the drawings and models accompanying the paper.

2. 'The Nerve Impulse in its Relations to the Strength of the External Stimulus,' by C. W. Greene.

The papers presented and read by title were:

1. 'A New Form of Mirror for Reflecting Telescopes,' by Chas. Lane Poor.

The mirror is a portion of a paraboloid of revolution, cut at the extremity of the parameter. The advantages over the old form were indicated as follows: Utilization of the full aperture; the reflected beam being at right angles to the incident light; no second mirror necessary; possibility of constructing mirrors of great focal length; possibility of such mirrors of short focal length, replacing photographic doubts.

2. 'A New Form of Equatorial Mounting for Reflecting Telescopes.'

With mirror of the above form an equatorial mounting becomes very simple; the declination axis becomes the telescope tube, the mirror being mounted at extremity of such axis and capable of revolving about it in a manner similar to the large flat of the equatorial condé.

The image is formed at the intersection of the polar and declination axes and is always in the same position; the observer, therefore, remains at rest while viewing any and every part of the visible heavens. A single reflecting surface replaces three in the reflecting equatorial condé, and four in the forms mentioned by Wardsworth. No dome is required. Many other advantages were indicated and several modifications of the general form pointed out.

Note. — Experiments with mirrors of the above form are now being carried out at the University.

CHAS. LANE POOR,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON, 274TH MEETING, SATURDAY, MARCH 27TH.

Mr. M. B. WAITE spoke on 'Factors Governing Pear Blight,' showing that the very conditions which were favorable to the growth of the tree were also favorable to the development of the disease, and that an important factor in combating the blight was the prevalence of a considerable degree of drouth.

Mr. Theo. Holm gave a historical review of our knowledge of 'The Grass Embryo and its Constituents.' He described the embryo as defined by Malpighi and authors of recent date, saying that there seemed to be good reason for adopting the explanation of its structure given by Malpighi more than 200 years ago. This involves the definition of both the 'scutellum' and the 'lobule' as independent leaves, while the 'pileole' thus becomes the first sheathing leaf or the second leaf proper after the cotyledon. A full account will soon appear in an article upon Fuirena, by the speaker, in the *American Journal of Science.*

Dr. E. A. De Schweinitz described 'Some Methods of Generating Formaldehyde and its use as a Disinfectant,' showing a specially devised form of lamp with a platinized wick by which large volumes of the gas could be readily generated.

F. A. LUCAS,
Secretary.

NEW BOOKS.

The Materials of Construction. J. B. JOHNSON. New York, John Wiley & Sons. 1897. Pp. xv + 787. $6.00.

The Principles of Mathematical Chemistry. GEO. HELM. Authorized translation from the German by J. LIVINGSTON R. MORGAN. New York, John Wiley & Sons. 1897. Pp. viii + 228. $1.50.

An Outline of the Theory of Solution. J. LIVINGSTON R. MORGAN. New York.

Plane and Solid Analytical Geometry. FREDERICK H. BAILEY, FREDERICK S. WOODS. Boston and London, Ginn & Co. 1897. Pp. xii + 371.

SCIENCE

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FRIDAY, APRIL 30, 1897.

CONTENTS:

The National Academy of Sciences: 669

An Essay on the Classification of Insects: JOHN B. SMITH. 671

How may Museums best Retard the Advance of Science? F. A. BATHER. 677

Internal Secretions considered in Relation to Variation and Development: ALBERT MATHEWS....683

A Layman's Views on Scientific Nomenclature: THEODORE ROOSEVELT. 685

Current Notes on Anthropology:—
Contributions to Ethno-botany; Cannibalism in Europe; The Pre-history of Northern Europe: D. G. BRINTON. 688

Scientific Notes and News:—
How Flowers attract Insects; The Scientific Exposition of the Government at the Tennessee Exposition; General: 689

University and Educational News....694

Discussion and Correspondence:—
The Re-distribution of Type-specimens in Museums: F. A. BATHER. *The Quarternary of Missouri:* J. E. TODD. *A 'driftless' Ridge:* O. H. HERSHEY. 694

Scientific Literature:—
Von Tubeuf on the Diseases of Plants induced by Cryptogamic Parasites: GEO. F. ATKINSON. *Recent Books on Quaternions:* ALEXANDER MACFARLANE 696

Scientific Journals:—
The Journal of Geology: H. F. B. 701

Societies and Academies:—
New York Academy of Sciences; Section of Geology: RICHARD E. DODGE. *Boston Society of Natural History:* SAMUEL HENSHAW. *The Texas Academy of Sciences:* FREDERIC W. SIMONDS. *The Academy of Science of St. Louis:* WILLIAM TRELEASE....702

New Books 704

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE NATIONAL ACADEMY OF SCIENCES.

THE annual meeting of the National Academy of Sciences in Washington began on Tuesday, the 20th inst., and continued through the following Wednesday and Thursday.

The meeting was remarkable for the unusually small number of scientific papers presented and the unusually large number of obituary notices and biographical memoirs read.

In the order of their presentation the scientific papers were: 'An Experimental Study of the Influence of Environment upon the Biological Processes of the Various Members of the Colon Group of Bacilli,' by Adelaide Ward Peckham (presented by Dr. Billings); 'On the Energy involved in Recent Earthquakes,' by Dr. Mendenhall, who, with Professor A. S. Kimball, presented a second paper on 'A Ring Pendulum for Absolute Determinations of Gravity,' the first being discussed at some length by Professors Agassiz, Rowland, Gilbert, Hastings and Mendenhall; 'On the Variation of Latitude,' by Dr. S. C. Chandler; 'On the Position of the Tarsiids and Relationship to the Phylogeny of Man,' by Dr. Theodore Gill; 'A New Harmonic Analyzer,' by Professors Michelson and S. W. Stratton; 'A report on the Variation of Latitude and Constant of Aberration from Observations at Columbia University,' the joint work of Professors Rees and Jacoby and Dr. Davis, presented

by Dr. S. C. Chandler; 'On Recent Borings in Coral Reefs,' by Professor Agassiz; and 'Notes on Experiments upon the Röntgen Rays,' by Professor Arthur W. Wright.

Biographical memoirs were read as follows: Of Dr. G. Brown Goode, by Professor Langley; of General Thos. L. Casey, by General Abbott; of Dr. Brown-Sequard, by Dr. Bowditch; of Professor H. A. Newton, prepared by Professor J. W. Gibbs and read by Professor A. W. Wright; and of Professor George H. Cook, by Mr. G. K. Gilbert.

Formal announcement was made of the death, since the last meeting of the Academy, of four of its members, including several of those most eminent and most widely known, namely, Dr. B. A. Gould, General F. A. Walker, Professor E. D. Cope and Professor M. Carey Lea.

Four new members were elected: Professor Morley, of Cleveland; Dr. Minot, of Boston; Dr. Dall, of Washington, and Professor Gooch, of New Haven.

On Wednesday Professor Asaph Hall was elected as Vice-President, to succeed General Francis A. Walker, who filled that office at the time of his death. Professor Remsen was elected to succeed Professor Hall as Home Secretary, and Professor A. Graham Bell was chosen as Treasurer of the Academy, to succeed Dr. Billings, who resigned that office, owing to his removal to New York.

Sir Archibald Geikie, Director of the Geological Survey of Great Britain, who is giving a course of lectures at the Johns Hopkins University, was the guest of the Academy at luncheon on Thursday, and was formally presented to the Academy at the session immediately following.

The plan agreed upon a year ago, of having the reading of papers begin at 2 p. m. and not attempting scientific work in the morning, was followed this year and will be productive of good results as soon as it is generally understood. It may be assumed that the Academy is indifferent as to whether it has an audience or not, and it is becoming quite evident that those who do not belong to it are pretty much of the same mind; but it is none the less a fact that there are always many people in Washington at the time of its annual meeting, including many residents and many temporary visitors, who would be glad to listen to the papers and discussions, and as long as the so-called 'scientific sessions' are avowedly open to the public, an invitation to attend being in some sense offered, some consideration ought to be given to those who often put themselves to much trouble to be present. The new plan of having a definite hour for beginning the 'scientific session' is an important step in this direction, and it ought to be followed by a rigid adherence to the order of the printed program in the presentation of papers. Often a member will invite those specially interested to be present at the reading of a particular paper, only to be disappointed by a change in the order to accommodate one whose title is lower down on the list. The Council has full power, it is assumed, to arrange the list as it deems best, but when once printed it should be adhered to, certainly, unless departure from it is by common consent.

The Academy is not only indifferent to the presence or absence of listeners, but it is probably equally indifferent to criticism from the outside; but having already ventured a word of critical comment, it will do no harm to add another and remark that if the formal introduction of a distinguished foreigner is an event likely to occur again it would be well to have some understanding among the few members who may accidentally be present at the time as to whether they are or are not expected to share in any way in the bestowal of this pleasant compliment.

On such occasions, and, indeed, on all occasions when the Academy is in session for other than the transaction of its private business, the presence of a goodly number of its members would be desirable, and it ought not to forget that it is a *National* Academy, chartered by the government; therefore to a degree the creature of the people and their representatives in the highest domain of scientific investigation. They do not wish to direct or restrict its operations, but are content to see that they are controlled by a membership which includes the ablest specialists which the country produces, selected from time to time in accordance with a standard with which they have no particular quarrel. On the other hand, the Academy may well give great consideration to its obligations to such an enormous and unusually intelligent constituency, whose character and dignity, from the scientific standpoint, it is delegated to represent.

The November meeting will be this year in Boston, beginning on Tuesday, the sixteenth of that month.

AN ESSAY ON THE CLASSIFICATION OF INSECTS.

OF late years the phylogeny of insects has attracted considerable attention from students, and much light has been thrown upon the subject by the researches made. One of the most notable facts has been the breaking away from the old Linnæan orders and the substitution of a number of more compact assemblages for some of the almost indefinable aggregations found in the old classification. New characters have been sought, not only in structures visible externally, but even in internal anatomical peculiarities. The subject is a very interesting one, which the teacher is of necessity compelled to study more or less, and which I was led to examine more particularly when the question recently came up as to the adoption of some system in a general work on 'Economic Entomology,' which has since been published. The conclusions reached by myself, while in general they agree with the latest published results, have been arrived at by a somewhat different method, and my ideas concerning the development of the orders are somewhat unlike those heretofore accepted. I have tried to adhere logically to a scheme of easy development, and have made use of some characters not heretofore particularly noted. Leaving aside for the present all questions as to the origin of the class 'Insecta' and as to its ancestors, I start from a developed hexapod—an archetypal Thysanuran with six, jointed legs; without wings; with or without abdominal appendages other than functional legs; with no eyes or with ocelli only; with a head not greatly differing in size or form from the body segments; with the thoracic segments equally developed and not greatly differing except in appendages from those of the abdomen. This creature lived in moist places, perhaps partially in the water, and had the tracheal system feebly or not at all developed; absorbing oxygen chiefly through the skin and tending, perhaps, as much in the direction of an aquatic as a terrestrial life. It had no distinct metamorphosis, was oviparous, bisexed, changing little in appearance from the time it emerged from the egg until it was adult and capable of reproduction. The mouth structures were generalized, feebly developed; but with at least three, and possibly four, pairs of composite structures corresponding to mandibles, maxillæ and labium of our existing insects. The possible fourth pair may have been an endo-labium and, perhaps, the labrum with its attached epipharynx may have required a fifth pair of structures. Most essential of all was an inherent power of variation and adaptation, and probably, as with some of our present Thysanurans, reproduction was

rapid and enormous numbers existed. The first important differentiation occurred in the mouth structure long before wings became developed, tending on the one hand to a perfection of all or most of the parts, or to a mandibulate type; on the other to a loss of certain of the structures, accompanied by a different development of the others, forming a haustellate type. In this latter branch the mandibles were never developed, the maxillary structures became elongated, separated into their parallel parts, and the labium became obsolete as a functional organ. Just how many intervening orders existed between *Thysanura emandibulata* and the best development of the haustellate structures it is impossible to say; but the only one in existence at the present time is *Thysanoptera*, also called *Physopoda*, otherwise *Thrips*.

This order I consider a distinct one on the same branch from which arose the *Hemiptera*, but forming merely a short spur and retaining characters which were soon lost in the main and more vigorous branch. It is a survival which has lost the power of further development, and can do no more than merely maintain itself. The main branch formed the *Hemiptera*, or, as I prefer to call them, the *Rhyngota*, of to-day; the mandibulate parts being completely lost, the labium losing all external appendages, and the maxillæ forming the jointed beak with its inclosed lancets.

The *Thysanoptera* and *Rhyngota* of all the existing orders are the only ones that do not have functional mandibles in some stage of their development. They are haustellate from their birth, and the character of the mouth parts never changes. In all the other orders, either larvæ or adults, or both, are mandibulate. I am aware that there are seeming exceptions in several orders, notably the *Diptera;* but it will hardly be disputed that this order is of a mandibulate stock, and many larvæ have the parts well developed.

It results from the views just stated that the *Thysanoptera* and *Rhyngota* are a division equal in value to all the other, or mandibulate, orders combined. They have their origin from the common stock; but were always haustellate or emandibulate in all stages, forming the first and lower of my main divisions. With the development of this branch, after its distinctive feature became established, I have nothing to do at present. It seemed adapted for variation in special lines only, and, as the method of feeding was practically fixed from the beginning, there is a remarkable similarity in mouth parts throughout.

The *mandibulata* possessed much greater powers of variation and a mouth structure in which all the parts were developed and capable of modification, containing possibilities of much greater range in obtaining food. They lived, therefore, under all sorts of conditions, in all sorts of media, and all kinds of modification were produced; some of them short-lived, adapted only to surroundings then existing; others with greater possibilities, that exist to the present time.

The first mandibulate insect had the thoracic segments similarly developed, all of about the same size and each of them free; but the advent of wings gave opportunity for radical divisions. I have no desire to go into details here more than necessary to explain my views of classification, hence will not pretend to account for the origin or development of wings. They did appear, however, and independently at several different points. In all cases the wings were net-veined or neuropterous in type, a peculiarity which is explicable if the venation be considered of a tracheal origin. With the appearance of wings many divergences in habit were made possible and new types began to appear. Three main lines branched almost simultaneously from the common stock, each of them fairly well marked from the beginning, retaining its

peculiarities and even intensifying them in all future subdivisions to the present time. In the first of these the prothorax, bearing no wings, became separated from the other rings and movable, or in a sense dominant. In both the others it tended to a reduction in size or to become agglutinated with or united to the others. In a general way it may be said that the series in which the prothorax is free is lower in the scale of development, as retaining a more primitive type. The orders belonging to this subdivision or branch are the *Dermoptera*, *Coleoptera*, *Plecoptera*, *Platyptera* and *Orthoptera*.

If we examine this series as a whole several characters will be found to challenge attention: First, a series of similarities in the mouth structure. Omitting the *Coleoptera* and *Platyptera*, which are most highly specialized, all the others agree in the general structure of the labium. In the Earwigs, Stone-flies and Roaches a divided ligula is quite usual, and throughout the *Orthoptera* glossa and paraglossa are usually separate and even jointed. In the maxilla of all the orders the lacinia may be said to dominate and the galea tends to become rather a subordinate, often palpiform structure. There are numerous exceptions to this in the *Coleoptera* to answer special requirements, but I believe that, as a whole, my statement is correct. The maxilla tends to the exercise of mandibular functions, and the lacinia is the sclerite armed and modified for the chief labor. Throughout this entire series of orders the head is fairly well set into the prothorax. There is no development of a distinct neck between the head and the first thoracic segment, and in many cases the head can be almost entirely withdrawn into the prothorax. This is an important feature which, so far as I am aware, has not been sufficiently valued. In wing-structure the secondaries dominate throughout, and the uniform tendency is to a reduction in size and loss of function in the primaries. Furthermore, the wings lie flat upon the back, and the secondaries are folded under the primaries. To this structure of the wings, and the method of carrying and folding them, I attribute much weight, for it seems to me that, combined with the other characters of head and thorax, it argues a community or origin and a separation from those forms differing in these features.

Among the most primitive in this series are the *Orthoptera*, of which the roaches and walking sticks are the most generalized in mouth structure as well as in the way the wings are carried. In this order the dominance of the secondaries as organs of flight is established, and the tegmina or primaries are more and more changed in character. The hind wings are always folded longitudinally under the primaries and sometimes both pairs are lost. In the primaries a gradual change in position occurs, part of the wing being first bent down in the crickets to protect the sides, the character becoming more prominent in the Locustidæ and most obvious in the Acrididæ which, in my opinion, are the highest of the order in point of development. Some of the roaches have the wings folded transversely as well as longitudinally, and this is a very primitive character which emphasizes the relation of these insects to the *Coleoptera* and points to a common ancestor.

A prominent feature in the *Dermoptera* and *Coleoptera* is that the secondaries are transversely folded, separating these orders at once from all the others except the few roaches already mentioned. It is, of course, true that there are *Coleoptera* in which the secondaries are not transversely folded; but these are secondary peculiarities and exceptions to the rule. I am inclined to attribute considerable importance to this character, and to give these orders an independent derivation from a Thysanuran

spur, very close, however, to the point from which the roaches originated. The *Dermoptera* cannot remain associated with the *Orthoptera* and present more affinities to the *Coleoptera* from my point of view. I do not mean to say that the Earwigs were the ancestors of the beetles; but that both were derived from the same spur in which the secondaries became transversely folded, and the *Dermoptera* now present some of the essential characters of the ancestral Coleopteron. The *Coleoptera* proved a vigorous shoot and stand far the highest of all those series with a freely movable or separate prothorax.

While the terrestrial branches were developing independently, two aquatic types, the *Plecoptera* and *Platyptera*, became developed, the larval forms living similarly under the surface of the water, but assuming a winged, aërial type before becoming capable of reproducing their kind. The *Plecoptera* or *Stone-flies* have the metamorphosis incomplete, while the *Platyptera* have it complete. The differences in this respect are very slight, however, and I have no hesitation in classing these forms together as comparatively small divergences from one stem. It will be noted that I use the term *Platyptera* in a different sense from any in which it has been heretofore employed, and do not include with it either the *Chrysopidæ*, *Hemerobiidæ* or *Myrmeleonidæ*. Raphidia and Mantispa, which seemed at first sight referable to this series on account of the elongate prothorax, do not really belong here, because this segment is not free, but is closely united at its base with the mesothorax. The *Plecoptera* are, of course, much the most primitive and are a survival, the main line of development continuing in the direction of the *Platyptera*.

The second branch from the Thysanuran stem started with all the thoracic segments nearly equally developed. While the prothorax was of good size and in the lowest forms quite free, yet the tendency was from the very start to unite it at its base to the other thoracic segments. In this series it is always fairly well developed, sometimes even very long; but it is always closely joined to the meso-thorax at the base and is not movable, while the tendency is for the head to become free from it, and at all events not to be inserted into the thoracic segment. While we do not have anywhere in this series a distinct neck, yet on the other hand there is nowhere a retraction of the head into the prothorax. In this series both pairs of wings are similarly developed, both as to size and as to general character, while the secondaries, though frequently covered by the primaries, are never folded beneath them in any way. The primaries are always functional.

The lowest in this series, and almost the simplest in general structure, are the *Isoptera*, where all the thoracic segments are well developed and the prothorax is scarcely dominant, though larger and almost free from the others. The wings are very much alike, the secondaries only a little larger than the primaries, and both are laid flat upon the abdomen. The mouth structures are almost identical with those of the earwigs and some of the *Orthoptera*. I believe the members of this order are among the most primitive of all the terrestrial winged insects now existing, and among the most ancient, though remarkably specialized in certain directions at the present time. Though at first glance it would seem as if these insects should belong to the series in which the prothorax is free, yet the character of the wing structure forbids this association and makes the *Isoptera* a natural stem from which were derived the *Mallophaga*, *Corrodentia* and *Neuroptera*.

The *Mallophaga* are a degraded parasitic type which were not improbably developed from a wingless Isopteron, and perhaps at about the time that the wingless forms of

the *Corrodentia* were also developed. The *Corrodentia*, and especially the winged forms, are peculiar in many respects and stand by themselves; but I believe that they are derivatives from the branch upon which I have placed them. I do not consider it at all improbable that in the *Corrodentia* wings were independently developed, and indeed cannot well explain the peculiar venation on any other theory.

The *Neuroptera* are evidently derivatives from the *Isoptera* stock. Here we have the prothorax well developed in all cases, sometimes very long indeed, but always united at the base to the meso-thorax and never movable. The wings are similarly developed, both pairs used in flight, the primaries covering the secondaries, but neither pair folded in any way. All the forms are terrestrial, as indeed are all belonging to this branch. In all cases the larvæ are predatory and have a similar appearance, in the younger stages at any rate. I exclude the *Sialidæ* from this order, because of the movable prothorax and the folded secondaries, and include of our American families only the *Mantispidæ*, *Chrysopidæ*, *Hemerobiidæ*, *Myrmeleonidæ* and *Raphidiidæ*. This branch is one of fragments, and all the groups belonging to it, or orders, if we choose to call them so, are of small extent. They may be considered remnants, and the branch as a whole does not seem to be increasing at the present time. It will be noted that as at present constituted it contains no aquatic species. Its point of origin, therefore, is very close to that from which the *Orthoptera* and *Coleoptera* branched.

The third series, in which the prothorax becomes much reduced in size and firmly articulated to the meso-thorax, has the body parts as a whole much more closely jointed and globular. The tendency is to bring the origin of the legs close together, and to the loss of the sternum as a distinct part or sclerite between the coxæ. The meso-thorax becomes dominant and best developed, bearing also the chief organs of flight. As a whole, subject to many exceptions, the tendency is to the development of the primaries, which are never reduced to mere wing-covers and never lose function. The tendency seems to be rather to a decrease in the size of the secondaries, as in *Hymenoptera*, and to their total loss, as in the *Diptera*. There is, however, a great deal of variation in this respect, and the most that can be justly said is that in this series the secondaries never become the only, or primary, organs of flight. Another point of very great importance is that here the head is nearly always more or less free or well separated, tending to the formation of a distinct neck; while there is never any insertion of the head into the prothorax. This fact will become very striking when the orders that are placed here are compared with those in the other section, and this difference in the articulation of the head has never been, in my opinion, sufficiently emphasized in our classification of the orders. It is closely correlated with the decrease, in size, of the prothorax.

In mouth structure the tendency is all in the direction of galear development in the maxilla, while the lacinia becomes constantly less important. In the *Diptera*, in which this series finds its highest development, the galea predominate over all other mouth structures. In the *Hymenoptera* the galea is always most highly developed, and particularly so in the bees, the most completely differentiated of all in the order. In the *Lepidoptera* the galea alone is developed into a functional organ, and in those net-veined orders in which the mouth parts are not rudimentary merely the galea is at least as well developed as and never subordinated to the lacinia. The orders in which I placed in this series are *Odonata*, *Ephemerida*, *Trichoptera*, *Mecoptera*, *Hymenoptera*, *Siphonoptera* and *Diptera*.

The *Odonata* presents the characters of the series in a very compact form and evidently had an early origin, though now quite decidedly specialized. As they exist at present they are the end of a very distinct line, once much more numerous than they are now, and they show us a survival of one of nature's experiments in methods of reproduction. The separation of the copulatory organs from the testes is a unique character for which some cause must have existed. I am aware that elsewhere similar separations exist, but I am not acquainted with any similar character in the *Insecta*. At all events the line leading to the Dragon flies was single, and none of our existing orders lead to it.

The geologic record, and their loosely jointed make-up, point to the *Ephemerida* as the most primitive in this series; but even here we have, well-marked in most of the forms, the free head, fairly distinct neck, unimportant prothorax, always closely joined to the meso-thorax, and the dominant primaries. The order has not varied much and is a survival; but from the same stem bearing the *Ephemerida* all the other orders of this branch have originated, giving them all a derivation from an aquatic larval type.

As the earliest spur from this branch we have the *Trichoptera*, in which the larvæ remain aquatic, but have assumed a cylindrical, caterpillar-like form, and from these the *Lepidoptera* were derived in comparatively recent times. The break between these two orders is not very great even at present, and in many of the *Lepidoptera* characters of a Trichopterous type may yet be distinguished.

The *Mecoptera* branched from the same stem with the *Trichoptera* with similar worm or caterpillar-like larvæ, some of which were probably aquatic; others lived in mud or moist ground, where some of them are still to be found, while yet others became entirely terrestrial. From one of the semi-aquatic forms the *Diptera* were derived. In the adult *Mecoptera*, instead of a loss of mouth parts, which was the tendency in the *Trichoptera*, we had rather a development of all the parts in parallel series, much as in *Panorpa*, which even at present retains many of the primitive characters.

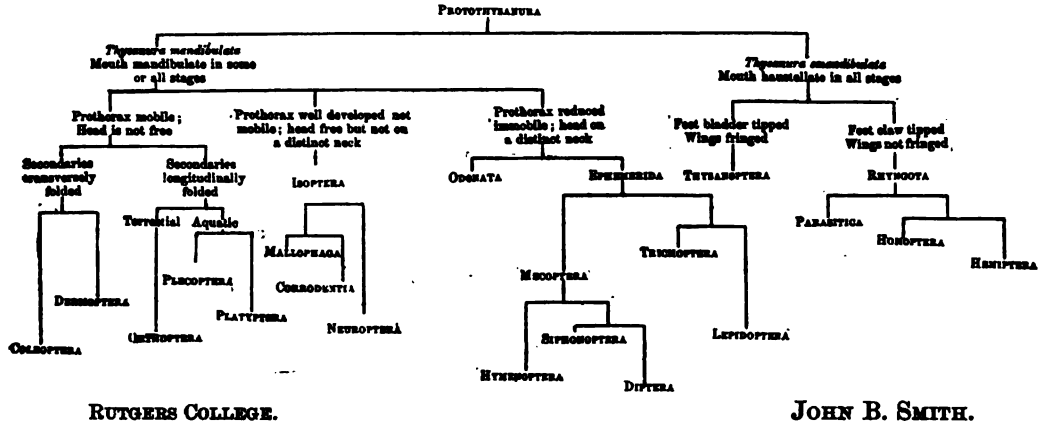
I am inclined to give the phytophagus *Hymenoptera* a much earlier origin than the *Diptera* and to derive them from the Mecopterous branch before it became very highly specialized. The *Diptera* seem to me to be the most recent of all the insect lines, and embody the highest type of that series in which the thoracic rings are united. Here the head is entirely distinct, the prothorax firmly united with the other rings, which are, themselves, solidly joined. The forewings dominate to the exclusion of the secondaries, and the galear structures of the mouth are the most highly specialized, showing, however, when closely studied, a remarkable resemblance to those of the *Hymenoptera* and pointing very strongly to a community of origin.

The *Siphonoptera*, or fleas, are entitled to ordinal recognition. They have much in common with the *Diptera*, but a type of mouth structure which could not possibly have been derived from the type now existing in that order. There is nothing, however, to prevent the belief that they developed from the same Mecopterous branch which culminated in the *Diptera*. In fact, the mouth parts of the fleas resemble those *Mecoptera* very interestingly in certain directions, and will be, I think, best understood by comparing them with that series.

I am quite aware that objections may be urged to this scheme, and that it is imperfect in some repects, but so also are all the others that have been proposed; and I believe, as I look at the matter, that my plan answers more of the objections than any other that I have seen. Nothing known

to me contradicts it more vitally than any other that has been proposed.

I have accorded very little place to the character of the metamorphosis, because there is no hard and fast line between complete and incomplete; but the closer comparative study of early stages will unquestionably help out our future classification. I have not made use of any one character as the basis of my scheme of division, because I do not think nature works in that way, and finally, I have used adult stages only, because I see in the adult ready to reproduce, the species. It is the culmination of individual growth, and until it is ready to reproduce it is incomplete, subject to change, and not an expression of the point to which its development has attained. In another form my scheme may be expressed as follows:



RUTGERS COLLEGE. JOHN B. SMITH.

*HOW MAY MUSEUMS BEST RETARD THE ADVANCE OF SCIENCE?**

VARIOUS subjects have at various times suggested themselves to me as appropriate for a paper to be submitted to this Association, but when I read the magnificently exhaustive address by Dr. Brown Goode, published in our last Report, it was manifest that all the ideas I had ever had were anticipated in that masterly production. There is, however, one side of our subject which has hardly had the attention paid to it that it undoubtedly deserves. We have been taught how best to arrange our museums for the satisfaction of the collector, of the student, of the investigator, or of the British public, but no one has ever pointed out to us the magnificent opportunities that are at our disposal whereby we may accomplish the great work of retarding the advance of science. It will perhaps not be wholly waste of time if we devote a few minutes this morning to considering this great power that is in our hands and how we may avail ourselves of it.

There are certain lines of conduct that are so surely and obviously prejudicial to science that the most uninstructed curator scarcely needs to be reminded of them. None of us but has been taught how to bewilder the eyes of the public with thirty specimens of an object, all placed the same way up, and displaying as few of its essential characters as possible, when one specimen properly labelled would have sufficed. We know how to strike dullness through the hearts of thousands by our funereal rows of stuffed birds with their melancholy lines of Latin names; we know how to chill the enthusiasm of the young and to disgust the susceptibilities of tender souls by the

* From Report of Museum Association for 1896.

display of entrails and abortions stewing in some brown decoction in the depth of antiquated pickle-jars. To suggest such well-known methods to the experienced audience of practical curators before me would be ridiculous and a waste of time. Fortunately there are further means that may be employed, and more subtle actions that may be performed, all tending to the same end.

First let us consider that jealousy with which a museum curator should guard the precious specimens entrusted to his care, forbidding the profane hands of the mere anatomist ever to disturb them in their holy rest. An excellent instance is afforded us by the history of the genus *Spirula*, of which an account has recently been published by Dr. Pelseneer in the Report of the 'Challenger' Expedition (Appendix, Zoology, pt. 83). Naturalists for long desired to obtain individuals of this interesting genus for dissection, but only fragmentary specimens came into their hands. At last, in 1865, a complete individual was collected near Port Jackson. The hopes of the naturalist were raised; "*but*," says Pelseneer, "but it was deposited in the Sydney Museum, and consequently could not be made the subject of anatomical research." There are other specimens in various public and private collections, notably in London; but they too, like the specimen in the Sydney Museum, cannot be made the subjects of scientific investigation. As curators we must regret that two specimens which were in the hands of a captain of the French navy, who for many years zealously refused to trust them to a zoologist—we must, I say, regret that, in the words of Pelseneer, "on the death of their owner, thanks to Professor Giard, these *Spirulæ* did not become the prey of a public collection." There are investigators so eaten up with their own conceit as to be bold enough to say that a specimen which shows nothing cannot be hurt by dissection, since it cannot show less and there is the chance of its showing more. Be not deceived! Do not allow the hidden recesses of your specimens to be explored by the devastating scalpel! What does it matter whether their internal anatomy can be seen or no? They have been entrusted to you for safe preservation, and you as a faithful steward will have to render account of the same.

The exhibition series of a museum are, in their essence, potent agents for retarding the advance of science. By mere force of circumstances, lack of time, undermanning, and so forth, the arrangement of specimens in the show-cases of a museum remains the same throughout many years, and names there applied to genera and species cannot be constantly changed. Classifications come and classifications go, but the classification that was adopted when the museum was built, say fifty years ago, seems likely to go on forever. Possibly even those who are in favor of introducing ideas into our scientific classifications, and who think that the arrangement of species and genera should be in accordance with their affinities and the facts of their structure, and, therefore, should change as our knowledge of that structure increases—even those fanatics, I say, may possibly regard this influence of museums as in some sort a chastening one. After all, it may not conduce to the advancement of science that each of us should have his own special classification and should call animals by his own pet names; and the museum here comes in, like its companion, the text-book, as a maintainer of stability amid the vagaries of ephemeral publication. Still knowledge *does* increase, science *does* advance, and classifications and names unfortunately do change. It is in our power to prevent this knowledge percolating to the mass of the people. If we are unable, like the text-

book writers, to foist upon the public senile illustrations that are nothing better than caricatures, still we can always excuse an effete arrangement or an obsolete nomenclature on the plea that we cannot possibly find the time or the money to re-arrange or re-name the specimens. We can, with much show of justice, refuse to give concrete form to the philosophic ideas of our greatest thinkers. We can refuse to allow our specimens to be experimented with, and arranged this way or that way according as a systematist may desire to check the working-out of his system.

Allied to the natural conservatism of museums is another efficacious practice. It is a well-known story that in the good old days of zoology, when species were regarded as separate creations, a profane sceptic ventured to ask one of our greatest zoologists what he really did manage to do with the connecting links. After looking carefully round the room, the zoologist whispered in reply, "My dear sir, I throw them out of the window." It is these window specimens that form the basis of our theories of evolution. It is by their means alone that we can work out the numerous problems that are pressing on us to-day—the problems of geographical distribution, the problems of heredity and growth, all the vast problems of the origin of our groups of animals. It is these window specimens that the museum curator always has suppressed with a stern hand; may he long continue to do so! How absurd it would be to expect otherwise! Under what names should we enter them in our registers? How could we place them in our cases? Where, indeed, should we find the room for the thousands of variations from the central types that are to be met with in all parts of the world? A museum, being finite, must select more or less, and if we select only those specimens that agree with the diagnoses of authors, we shall be saving both ourselves and the authors a vast amount of trouble. With regard to the numerous details valued by that exacting creature, the modern biologist—details of locality, of season, or, in the case of fossils, of the definite zonal horizon—it is hardly necessary to add that their accumulation would involve the curator in enormous labor, and if indulged in would probably lead him to the collection of an absurd number of specimens.

All that I have yet said may be summed up in the one phrase 'Shun ideas!' Would it be believed that a certain Professor Herréra, of the National Museum of Mexico, has recently produced a paper in which he says that the museum of the future is to be a museum of ideas? "There will be no gallery of birds, or of mammals, or of fishes, or of reptiles; no collection of Coleoptera, no collection of Chiroptera or of pheasants, or of pigeons. Museums of the future do not classify by classes, families, tribes, genera, species, sub-species, varieties, sub-varieties, races and sub-races; they put in order facts and classify ideas. There are rooms for heredity, for ontogenesis, cœnogenesis, variation, mimicry, the struggle for life, nutrition, and so on. These rooms are arranged in a philosophical order, and in that order they must be visited by the public; to this end there will be barriers suitably disposed. In the museum of the future the specimen is the lacquey of an idea; whereas, in our present museums, ideas are the slaves of specimens. Thus a specimen is not exhibited because it is rare or because it ought to be exhibited; we show the most profound contempt for specimens that are rare, curious or pretty. The museum of the future aims at being, not a magazine of dead lumber eaten by worms, but an open book in which men can read the philosophy of nature." And, after suggesting some ideas that may be exemplified in museums, our author concludes, "but, instead of studying these ideas and exhibit-

ing them in his museum, from time immemorial man has tried to imprison the things of nature in a fixed system, a fixed classification, which is not the whole of science, and which cannot be the nest of the whole of philosophy. Nature, in her vastness, protests against the classifiers; maddened, indignant, despairing, she revolts against routine." What rubbish! How can the curator at £70 a year be expected to have ideas of this kind? And how assuming that he has found the intelligence, how can he spare the time to put them into operation? And what would our Boards of Governors, our Trustees, our Town Councils, say if they went into a museum and found a curator, instead of mounting specimens by the hundred, and making as large a display as possible, calmly sitting at his table reading the 'Origin of Species,' or the latest number of the *Archiv für Entwickelungs-Mechanik?*

Apropos of the curator, he has been described, and very rightly, as the soul of the museum. What kind of a soul does the museum want? It is obvious that the curator should not be a scientific man; for if he be he will constantly be led astray from his work of labelling, ticketing, mounting, and so forth, to investigate the relationships, distribution, and what not, of some new species that has come into his hands; or, in tracing out some peculiar facts of anatomical or historical interest, he will waste the time that should be employed in compiling a list either of specimens figured by others or of his own grievances. The function of a curator is to keep his specimens clean, to keep them in order, and to exhibit them in such manner as will satisfy the annual visitation of his Board of Trustees or his Town Council. The motto that the curator should hold before his eyes is that famous one, 'Surtout point de zèle.' It is not for him to add to the stores of the museum by spending his Sundays in the country collecting fresh specimens, or his holidays in foreign lands to verify the localities whence specimens have come. It is not long since a paper was read before this very Association, read, I regret to say, by a person for whom I am in some respects responsible, recommending that the museum assistant should be sent out "to collect in the fields, the rocks and the seas," then that he should "study the specimens that he has collected, each of which will have for him an interest and a living history which under present conditions it never has; by their means he will extend the boundaries of knowledge and confirm the foundations of system, so that it is for him an expression of universal thought, and no longer a mechanical device for sorting species into their places. Then, with this vitalized classification, and with some real meaning in his head, he will proceed to prepare his most instructive specimens for exhibition, so that the final result may convey to others something at least of the beauty he himself has found in the world."—So too, at the beginning of the century, P. A. Latreille wrote in Sonnini's edition of Buffon ('Insectes,' I., p. x.) "L'homme, qui n'étudie les Insectes que dans son cabinet, peut être descripteur; mais il ne sera jamais, à ce que je pense, un profound entomologiste." But the curator does not require to be 'un profond entomologiste,' 'un profond géologiste,' 'un profond biologiste,' or anything that remotely resembles a scientific man. The curator should take for his pattern and exemplar the clerk in a dry-goods store.

We turn now to a certain practical detail in the arrangement of our museums, which fortunately seems to commend itself to the outside public who are not scientific people, and especially to the donors of specimens and bequeathers of collections. I mean this idea of keeping certain collections separate according as they happen to have

belonged to some person with a lengthy name, or to have been described by some pottering genius of the locality, or, perhaps, merely to have been presented by some individual, who, because his name was utterly unknown, desired to adopt this method of bringing it into prominence, and laid it down in his will that his specimens were to be known for all eternity as the 'Peter Smith Collection.' This method, at all events, places an insuperable bar in the way of our associating specimens that the student wishes to compare, and enables us to hide from the gaze of the traveling man of science specimens of historic interest that he may have come to our museum on purpose to see. Permit me here to indulge in a fragment of autobiography. Many years ago I journeyed to Strassburg on purpose to examine certain specimens that had been described by Mr. de Loriol. The various curators whom I met at the museum assisted me very willingly throughout three days searching for these specimens, but they could not be found, and I went on my way sorrowing. Arrived at Freiburg, I mentioned the fact to my friend, Professor Steinmann, who suggested that possibly the specimens might have been overlooked as being in the Cartier collection. At considerable expense and inconvenience I, therefore, returned to Strassburg, and, sure enough, there were the specimens carefully obscured. I have known instances of eminent foreigners coming to a great museum in our own country, desirous of inspecting certain remarkable specimens, and, after searching for many hours in the cases, where all logic would lead one to imagine the specimens were, learning at last that they were at the other end of the museum because they had once belonged to some vainglorious amateur, or been described by some muddle-headed genius of the dark ages. Who, after this, can say that such a system is not to be encouraged?

Somewhat akin to the distribution of specimens among various collections, and equally efficacious as a skid on the wheels of science, is the practice that still obtains in the majority of our museums of separating recent and fossil forms. It is necessary that I should say some words about this, because there are in this and other countries certain people who strongly urge the amalgamation of these collections, coming out with such absurd *dicta* as that one specimen should not be separated from another because it happens to be preserved in stone instead of in spirits, maintaining that the evolution of life and the relations of the present to the past are far more easily seen if one has not to walk several hundred yards to see the living ally of a fossil species. They also believe that the zoologists are led into errors through their ignorance of extinct animals, an ignorance largely fostered by the museum custom of keeping them apart; and they deny that the paleontologist can properly understand the fossils with which he deals so long as he is prevented by the assumed necessities of museum arrangement from studying living forms *pari passu*. An intimate friend of my own, who happens to be officially connected with one of our greatest scientific establishments, has privately complained to me that his studies found yet another difficulty in the fact that the books which are supposed to deal with modern life are placed in two or three separate rooms at a considerable distance both from one another, and from the room that contains the books dealing with extinct life. Nor is this all. He adds that, when the necessities of the case compel him, as they often do, to visit one of the other libraries, he is actually scowled at as an intruder by his fellow-workers in that department. It is clear that in the institution to which my friend has the honor to belong the true museum-spirit is still flourishing with vigor. It is this

spirit, this idea of separation, of privacy, and, as it were, personal property, to which the Greeks appropriately applied the term ἰδίωσις—it is this that we curators must continue to foster, if we are seriously desirous of retarding science.

To carry on the ἰδέα ἰδιωτικα: a Museum should keep itself to itself; it has nothing to do with the Free Library, with the University, or with the Zoological Gardens. Do you wish to be overpowered by a lot of rowdy students coming and pawing over your specimens; or do you, as a peace-loving curator, wish to be dragged off to give an opinion upon some new accession of an animal that is possibly dangerous? Remember, too, that by this cooperation your collections are likely to be increased to an unmanageable extent and your hours of labor will be lengthened without a corresponding rise in salary.

This leads me to consider an exceedingly difficult question—the lending-out of specimens. It is, as you are aware, the rule of the British Museum never to let a single specimen that has once been registered pass outside its walls, except as a donation or an exchange. Other museums are either, as you may prefer to term it, less careful or less miserly. There can be no doubt that science is greatly advanced when a reliable investigator, working in one locality, is able to borrow from the museums of other cities or of other countries specimens that will aid his labors. On the other hand, there is this to be said in favor of the proceeding: that in a large number of cases the specimens that are thus loaned never return to the museum, and ultimately are lost to science. It therefore does not very much matter, so long as, if you lend them, you conveniently forget whither they have been sent, and so long as, if you keep them, you place the necessary obstacles in the way of the investigator.

But it may be retorted to the last argument: there is another way whereby these difficulties are avoided and science greatly advanced. *Videlicet*, one museum can exchange type-specimens or special collections with another. Such a solution of the problem was laid before us at Dublin by Dr. H. O. Forbes. Now, on this question of the dispersal of types, a conversation that I had with a leading English entomologist impressed me forcibly. New species of insects, he said, are being described at the rate of about *6,000 per annum*. Those who attempt to coordinate the scattered descriptions cannot possibly do so without comparing the type-specimens. Experience shows it to be impossible for even an expert to draw up a description that shall be accepted as recognizable by another expert. Further, no entomologist of ordinary human powers can retain in his memory the conception of any one species, much less of three or four hundred, sufficiently well for him to compare specimens in one museum with those in another, unless he can set them side by side. For any real advance in this subject, the type-specimens of all the species of a family must be gathered together in one room, so that the specialist may examine and compare them directly. This could be done, either by the various type-specimens being lent for some time to another museum, or by a permanent interchange of specimens—one museum specializing in Hymenoptera, another in Diptera, and so on. The difficulties are felt most strongly in entomology, but they affect ornithology, botany, conchology, and other branches of systematic biology to a marked extent. Obviously, then, we have it in our power to retard the advance of these sciences, or even to check it altogether, by jealously guarding our treasures, either forbidding them to leave their abodes under any circumstances whatever, or cleaving to our type-specimens as to some musty but sacred heirloom, useful only to aliens, but

a tattered badge of pride to ourselves. Here is a weapon, the use of which has far-reaching results that appeal to the imagination with the certain annihilation they inflict. Fellow-curators, grasp your weapon, and, more powerful than Canute, force back the advancing tide!

F. A. BATHER.

BRITISH MUSEUM (NAT. HIST.),
LONDON, S. W.

INTERNAL SECRETIONS CONSIDERED IN RELATION TO VARIATION AND DEVELOPMENT.

THE so-called internal secretions of glands and other organs consist of products manufactured by them and passed back to the blood. Many of these products are known to be of very great importance to the adult organism; it is possible that they may be of no less importance to the developing organism and that we may here find a clue to some of the unsolved problems of development. Internal secretions have probably been longest recognized in case of the reproductive organs. The effects of castration, of non-development or development of these organs are well known. It has also been generally recognized that the influence of these organs depends on substances formed by them and given to the blood. What these substances are is still unknown, but there can be little doubt that their presence determines the development of other organs and characters, the so-called secondary sexual characters. The long recognized healing effect of removal of the ovary in women suffering from soft bones and the subsequent growth of bone and fatty tissue has been the subject of researches by Curatulo and Tarulli.* These authors concluded that the ovaries produce a substance which oxydizes the organic phosphorus compounds and thus cause their rapid destruction. The removal of the ovaries would seem to remove the destroying substance and hence to cause a deposition of phosphorus, and experiment showed that after extirpation of the ovary the excretion of phosphorus fell off one-half.

Perhaps the best known internal secretion is glycogen. This substance, made by the liver and given to the blood, is used as food by many other organs. Thanks to Hedin, Minkowsky and others, the internal secretion of the pancreas is now known to be a necessity to the organism, for if this organ is extirpated, the animal (mammal) quickly dies from diabetes mellitus. What the active substance is and whether it acts directly on the liver or through the nervous system is not yet decided. Equally important internal secretions are produced by the thyroid and thymus glands and the suprarenal capsules, the complete extirpation of any of which leads to rapid death, though life may be prolonged for a longer or shorter time by feeding the animal with the missing organ or injecting its extract into the system. Very striking is the effect of non-development or over-development of the thyroid on the cranium. The low broad skull of the cretin forms a distinct type, and the rapid change in physiognomy in patients suffering from goitre after the reduction of the thyroid or the injection of thyroidin is well known. According to Brown-Séquard, the fatal results of extirpation of the kidney are due not to poisoning by urea, but to the lack of an internal kidney-secretion essential in some way to the organism. There can be no doubt that the muscles also form such a secretion, for it has been shown that the excitation of the breathing center on muscular activity is the consequence of some chemical substance given by the muscle to the blood. Perhaps a similar secretion is the ammonia manufactured by the mucous membrane of the stomach and carried to the liver, there to be elaborated into other products. Although such substances have not yet been

*Phys. Cent. IX.

isolated from the brain, salivary glands and some other organs, there seems good reason to believe that even these furnish to the blood substances peculiar to them.

It is, therefore, highly probable that all organs have besides their obvious function, a hidden function, in the maintenance, by means of their internal secretions, of the metabolic equilibrium of the body. Further, many of these secretions are absolutely essential to the life of other organs, and in certain cases, as in the thyroid and reproductive organs, they are necessary to the development of organs apparently not in any way connected with them. There can be little doubt that one of the prime uses of the blood is as a distributing agent of these substances, and that its coördinative function is one of its most important offies.

We are thus led to a possible explanation, along these lines, of the organic unity of organisms unprovided with a nervous system. It is highly probable that the internal secretions play an important rôle in the correlation of parts in the higher organisms. It is possible that this rôle becomes the principal one in case of the developing embryo or of organisms like the plants which have no nervous system. The internal secretions are also of interest in their bearing on the correlation of variations.

If an organ in one part of the organism depends in any manner upon the internal secretion of some other organ we may understand how the increased developement of the one may lead to an increased development of the other, though apparently in no way connected with it. Thus we could see how variations have arisen and how they have been perpetuated until they are themselves useful. Many organs, the beginnings of which could hardly have been useful enough to be acted upon by natural selection, may have been developed because they are correlated by means of their internal secretions with other organs which are useful. It would also be clear why certain organs or groups of organs vary together. If such organs are mutually interdependent in the manner indicated, then the diminution of one necessarily means the diminution of another and another and so on. In certain cases the diminution of one may lead to the growth of another organ. This is, perhaps, most strikingly seen in the case of castrated cattle, which are proverbially large boned and fat, the growth of the bone being correlated with the diminution of the internal secretion of the sexual organs. In another case, where two organs were dependent on the internal secretion of some third, the suppression of one of the two might lead to a compensatory growth in the other.

That the internal secretions play a part in embryonic differentiations seems very probable. Striking examples of their importance in the later stages of development are afforded by the thyroid and the reproductive glands, already referred to. Lack of development of the thyroid hinders the development of the cranium and the whole body. If cretins be fed on thyroid they increase both in size and intelligence. The development of the sexual organs is essential to that of many other so-called secondary sexual characters. The same may very well be the case in the embryo. Thus an organ called into being by a previous organ may in its turn determine, through an ininternal secretion, the development of a succeeding organ; and we should here have an explanation of the persistence of rudiments, or the temporary appearance of glands and organs which later disappear and seem to fulfill no function whatever. They may be necessary to the organism through their internal secretions, which give the necessary stimuli to the development of other organs which are permanent.*

*See note at end.

I would suggest also that the internal secretions may possibly give the explanation of the modifying influence of the male element on the surrounding mother-tissue forming the fruit in plants. Darwin notes many cases of hybrids in which the fruit, though composed of purely maternal tissue, nevertheless plainly shows paternal characters. He explained these cases by the wandering of the pangens. It is not impossible that his 'pangens,' not only here, but in other cases, may be nothing else than the internal secretions. There can be little doubt, furthermore, that the internal secretions from the fœtus play a very considerable part in the modification of the maternal organism during pregnancy.

The foregoing suggestions are difficult of proof, but they do not seem to me inherently improbable, since it is altogether unlikely that the metabolic coordination, which certainly exists in the adult organism, comes into being only after the close of embryonic development, and only in such organisms as possess a well developed vascular system. It is well, too, to bear these internal secretions in mind in the study of the development of organisms. Such an organ as the shell-gland of the molluscs may be of vastly greater value to the organism as a manufacturer of an internal secretion than as the maker of a protective shell.

ALBERT MATHEWS,
Former Fellow in Biology, Columbia University.
MARBURG, GERMANY.

[NOTE: The above interesting suggestion regarding the physiological *rôle* of internal secretions in development is, as far as I know, new. It is obvious, however, that the interpretation given of rudimentary or temporary organs in development is nearly related to that of Kleinenberg, with which the author is apparently unacquainted. Kleinenberg long since held that the permanent parts of the embryo might appear and be guided in their development 'through the stimulus or by the aid' of 'rudimentary' as well as of obviously functional organs; and that 'when these (the permanent organs) have attained a certain degree of independence the intermediary organ, having played its part, may be placed on the retired list' (*Lopadorhynchus*, 1886, p. 223). Mr. Mathews' suggestion has the great merit of supplying an intelligible working hypothesis regarding the nature of the 'stimulus' or the 'aid' given by the intermediary organ, and it seems well worthy the attention of experimental embryologists.

E. B. W.]

A LAYMAN'S VIEWS ON SPECIFIC NOMENCLATURE.

ANYTHING that Dr. Hart Merriam writes is sure to be of great value. He is one of the leading mammalogists and he has laid all men interested in biology under a heavy debt by reviving the best traditions of the old-school faunal naturalist and showing that among the students of the science of life there is room for other men in addition to the section cutter, the microscopist and the histologist. There are a good many of us who look forward to the publication of his great work on the North American Mammals, including their life histories, as to something which will mark a real epoch in scientific work on this continent.

Having made this kind of preface, everyone will naturally and rightly conclude that I intend to say something in dissent from some of Dr. Merriam's views. I have just been reading his very interesting pamphlet on the smaller North American wolves, commonly called prairie wolves, or coyotes. His facts and deductions are most important; he has shown for the first time how many different races of coyotes there are, together with their inter-relationships and

their distribution in groups which coincide with the geographical divisions of their habitat. For the way in which he has worked out this, the most important, part of the article, no one can feel anything but admiration. But I quarrel with the terminology by which he seeks to describe the results at which he has arrived. He divides the coyote into a large number of different species, giving to each full specific rank and a specific name, in accordance with the theory of binomial nomenclature.

Now, terminology is a matter of mere convenience, and it is nothing like as important as the facts themselves. Nevertheless terminology has a certain importance of its own. It is especially important that it should not be clumsy or such as to confuse or mislead the student. Although species is a less arbitrary term than genus, still it remains true that it is more or less arbitrary. If one man chooses to consider as species what other men generally agree in treating merely as varieties it is unfortunate, both because the word is twisted away from its common use and further because it confuses matters to use it in a new sense to the exclusion of the word commonly used in that sense. Moreover, it is a pity where it can be avoided, to use the word so that it has entirely different weights in different cases.

I can illustrate what I mean by reference to the terminology used in describing the geographical distribution of mammals. It is not very important whether we call the great primary division of the world, faunistically considered, realms or regions. But it is important that we should not use the words first in one sense and then in another, and above all that we should not use the same word with totally different values. For example, Mr. Wallace's classification was absurd in so far as he made the Nearctic, Palearctic, Neotropical and Australian regions of equal value. There are differences between the mammalian faunas of northern North America and northern Eurasia, but they are utterly trivial as compared with the differences which divide the fauna of both regions from the fauna of either South America or Australia, or indeed of South Africa. To indicate by the nomenclature used that the differences are of equal importance in the four cases is as misleading as it would be to describe the ethnology of the United States in terms that would imply that the New Englanders, the Kentuckians, the Indians and the Negroes formed four divisions of about even rank. There are differences between the New Englanders and the Kentuckians; but no one would dream of distinguishing the two by terms that would imply that they were as widely separated as either is from the Indians or Negroes.

It seems to me that the same principle should hold true of the excessive multiplication of specific terms to describe the different varieties of a group of animals like the coyote. Specific as well as generic terms are quite as useful in denoting likeness as in denoting unlikeness. The excessive multiplication of the species in the books cannot, as it seems to me, serve any useful purpose, and may eventually destroy all the good of the Latin binomial nomenclature. In the group of wolves, for instance, so far as North America is concerned, the really important points to remember and to bring out are that there are two types: one, the small wolf, the coyote, which, wherever found, is sharply separated from the other, and only exists in a portion of North America; and the other, the large wolf, which is much more widely distributed over North America than the coyote, and is practically identical with the wolf of Europe and north Asia. There are a great many varieties of each, just as there are doubtless a great many varieties of wolves in Europe and north Asia. Among coyotes

it is an interesting fact that the coyote of the Little Missouri is bleached compared to the coyote of the upper Mississippi, and that he has larger teeth than the coyote of the Rio Grande; but it seems to me to be unwise to separate all these forms by giving them rank that would imply that they differ from one another as much as they differ from the great gray wolves of the same region. I understand perfectly that this is not what Dr. Merriam means, and that he would subdivide the genus into various groups so as to show that the species are not of equal value. Nevertheless, the fact remains that the important point is the essential likeness of all the coyotes one to the other, and their essential difference from the big wolves with which they are associated, and which are themselves essentially like the big wolves of Europe and north Asia; and it seems to me that these facts can best be brought out by including the coyote and the wolf in one genus and treating each as a species. Then the geographical and other varieties may or may or may not be treated as worthy of subspecific rank according to the exigencies of the particular case. The alternative is to use terms of super-specific value, including groups of minutely separated species; and this would be clumsy and would hardly seem worth while.

I will illustrate what I mean by referring to some other mammals. The points of resemblance between beasts like the wolverines, the beavers and the moose of the two northern continents are far more important than the points of difference. In each of these cases it does not matter much whether these animals are given separate, specific rank, because in each case the Old World and the New World representatives make up the whole genus; but even here it would seem to be a mistake to separate them specifically unless they are distinguished by characters of more than trivial weight. The wapiti and Scotch red deer, for instance, are markedly different, and the differences are so great that they should be expressed by the use of specific terms. If the American moose and Scandanavian elk are distinguished by specific terms of the same value, then it ought to mean that there is something like the same difference between them that there is between the red deer and the wapiti, and as far as our present knowledge goes this is not so. The wolverines, beavers and moose of the two continents should only be separated by specific terms, if the differences between each couple are of some weight, if they approximate the differences which divide the red deer and the wapiti, for instance—and I know that even these two may intergrade.

I would not dogmatically assert that even though forms intergrade they should not be sometimes separated by specific titles. In their extreme forms the grizzly bear and the little black bear are certainly utterly different, and I have shot these extreme forms within a mile of one another on the Big Horn Mountains. Whether they intergrade or not, there should be a sharp line of difference drawn between the typical representatives of these two kinds of bears; but I confess that I think that many of the multitude of 'species' of holarctic bears will have to be reduced to less than specific rank before we get a very clear idea of the true relationship of the bears of North America and northern Eurasia. The excessive multiplication of species based on trivial points of difference merely serves to obscure the groupings which are based on differences of real weight. Moreover, it has always seemed to me unwise to make the word species depend solely upon the accident of the survival or non-survival of some connecting link. Two closely connected forms may not intergrade, while two widely separated forms may; and it seems to me the term species should express the

fact of a wide and essential variation rather than the accident of the existence of a connecting link.

One more example and I am done. The cougar, or puma, is a perfectly distinct and well marked kind of cat, noteworthy not only for the sharpness with which its color and other points differentiate it from its spotted relatives, but also for the extent of its range. It seems to me it would be unwise because of any trivial differences to establish various species of cougars, separating the different races by terms of the same weight by which we separate, for instance, any one of them from the totally different jaguar. Here again the essential point is the likeness the cougars bear to one another, and their wide unlikeness to the great spotted cats. The Latin name we give them should indicate, by the employment of the generic term, their resemblance to all other cats, and by the employment of the specific term their fundamental agreement among themselves on points wherein they differ from all other cats. Of course, it would be possible to make the pumas into one genus, with another for the leopards, another for the lions, etc., etc.; but this again seems to me to be clumsy and, on the whole, misleading.

I quite realize that there is a certain amount of presumption in a layman criticising any conclusion reached by a trained scientific expert of the standing of Dr. Merriam. It must be remembered that my criticism is directed only to the expediency of the terminology by which he expresses certain of his results, and not in the least to the results themselves; in fact, it is because I am so ardent an admirer of Dr. Merriam's work that I wish to see it made, without any sacrifice of accuracy, so comprehensible in its terms as to be easily understood by the lay mind.

THEODORE ROOSEVELT.

CURRENT NOTES ON ANTHROPOLOGY.

CONTRIBUTIONS TO ETHNO-BOTANY.

IN the last number of the *Internat. Archiv für Ethnographie*, the editor, Dr. Schmeltz, reviews the progress of ethno-botany, referring with special emphasis to Professor Guppy's 'plant names of Polynesia' (published by the Victoria Institute, 1895). Such studies cast a light upon the early migration of tribes which cannot be obtained from other sources.

An interesting example is given in the *American Anthropologist*, February, by Mr. Walter Hough. It is upon 'The Hopi in relation to their Plant Environment.' How important their floral world, sparse as it is, has been to this people may be judged from the author's remark: "There is almost no plant which the Hopi do not use in some way, and there is none to which they have not given a name." An ample list is added, including the native name, the botanical title and the use to which the plant is put.

CANNIBALISM IN EUROPE.

WE rarely reflect how near in time modern civilization is to savagery. Less than a thousand years ago the Picts of Great Britain were man-eating barbarians. The recent researches of Matiegka, in Bohemia, prove that anthropophagy prevailed there in the bronze age (*Centralblatt für Anthropologie*, January, 1897). If we can trust mediæval authorities quoted by Dr. Krauss in the *Der Urquell*, B. I., they held distinctly in memory the period when the Wends and Slavs 'killed, cooked and ate' their aged relatives.

But this is quite surpassed by the evidence addicted by the same writer that the southern Slavonians even down to well within the present century were familiar with the custom of ceremonially eating the flesh of their enemies. Indeed, one of their songs, as late as 1820, refers to it as a recognized procedure. To taste the broth

made with the head of some famous warrior was believed to confer on women the possibility of similarly heroic offspring!

THE PRE-HISTORY OF NORTHERN EUROPE.

MAN first entered northern Europe in the Neolithic period; but that period, for that locality, is divided into an older epoch, when flint implements were not polished, and a later, when they were polished. The first of these was the age of the oldest Danish kitchen-middens; the oak was abundant there and in Scandinavia; but the men of the time did not carry on agriculture. The climate was warmer than it had been since. This epoch closed about 3000 B. C.

About that time the cultivation of barley and wheat was introduced, polished flint implements were manufactured, the beech began to abound, and the later refuse heaps and the dolmens were constructed. The distribution of this early culture indicates that it approached the north of Europe from the Iberian peninsula and probably from North Africa.

Such are the conclusions reached by Dr. E. H. L. Krause, in *Globus*, Bd. LXXI., No. 9, from the works of Andersson, Montelius and Meitzen.

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SCIENTIFIC NOTES AND NEWS.

HOW FLOWERS ATTRACT INSECTS.

PROFESSOR FÉLIX PLATEAU, of Ghent, has been making further careful experiments in the open air to determine what part the corolla and other conspicuous parts of the inflorescence of flowers bear in attracting insects, and has reached some results strikingly at variance with generally received opinions.

His first series of experiments (see SCIENCE, N. S., III., 474) were made on composite flowers with radiate inflorescence and resulted in the conclusion that their form and color play no part in attracting insects, these being guided by some other sense than sight—probably by odor.

In a second series he mutilated flowers of Lobelia, Œnothera, Ipomaea, Delphinum, Centaurea, Digitalis and Antirrhinum, with a wholly similar result, viz, to show that the colored organs of these flowers play a very unimportant rôle.

Further experiments, related in a third paper, lead him to make the following statements as their conclusion:

1. That insects show the most complete indifference for the different colors which flowers of the same species or of the same genus may present.

2. That they fly unhesitatingly toward flowers habitually neglected by them on account of their total lack or small supply of nectar, the moment one places in them an artificial nectar, represented by honey.

3. That they cease their visits to flowers from which the nectiferous portions have been eliminated (but in which the inflorescence remains intact) and that they renew their visits if one afterward replaces the eliminated nectar by honey.

The details of these experiments and observations are given with the utmost care and their importance cannot be questioned. The results are published in the *Bulletin* of the Belgian Academy.

SCIENTIFIC EXHIBITS OF THE GOVERNMENT AT THE TENNESSEE EXPOSITION.

DR. W. F. MORSELL writes that the government scientific exhibits for the Tennessee Exposition, which opens on May 1st, are well advanced. Exhibits will be made by the National Museum, taken from its numerous departments, and the Smithsonian Institution will include in the complete set of its publications the book prepared in celebration of its semi-centennial. The Bureau of International Exchanges will show the extent of its work, and astronomical photographs will be sent from the Astrophysical Observatory. The Zoological Park will send a model of the Park about seven feet square, and the Bureau of American Ethnology will present a Kiowa camping circle.

The exhibit of the United States Geological

Survey will embrace two cases of minerals and a case of fossils. It will also include a suite of the rocks of the Educational Series. This is one of a number of duplicate suites, each consisting of 156 typical rocks, which the Geological Survey has been preparing for a number of years, to be distributed to universities and colleges for purposes of instruction. In addition to the above, the Survey will show twelve or fifteen relief models, most of them very fine, and a large collection of the topographic maps and geologic folios, as well as a number of transparencies and pictures of various kinds.

The exhibit of the Department of Agriculture is designed to show as completely as possible the character of the scientific work which this Department is doing in developing the agricultural resources of the country. Each one of the scientific bureas and divisions will have its allotted space, with characteristic exhibits of its peculiar functions. The Weather Bureau will show a complete set of the instruments used in observing the weather, with its maps, charts, etc.; the Bureau of Animal Industry, typical specimens of animal parasites and illustrations of animal diseases; the Forestry Division, the forest resources of the country, particularly of the South; the Division of Entomology, the insects most injurious to Southern crops, with wax models of the corn and the cotton plant, insecticide apparatus, etc. The office of Fibre Investigations will show specimens of economic fibres (hemp, flax, etc.); the Division of Pomology, wax models of native fruits; the Division of Vegetable Pathology, specimens illustrating typical plant diseases; the Division of Biological Survey, the birds and wild mammals of the country, and the Division of Botany, useful and harmful plants. This Division will show also specimens of the various useful seeds, and will illustrate the methods employed in the Department's seed-testing laboratory. The space allotted to the Division of Agrostology will be devoted to a display of the grasses used for forage, for binding sandy soils, etc.

GENERAL.

Professor Henry Sidgwick, professor of ethics in Cambridge University, has been elected a member of the Danish Royal Society of Sciences; Professor Rudolf Heidenhain, professor of physiology at Breslau, a member of the Royal Society of London, and Dr. Salenski, sometime professor of zoology in the University of Odessa, a member of the St. Petersburg Academy of Sciences.

The Honorary Medal of the Royal College of Surgeons was presented to Lord Lister and Sir James Paget at the last meeting of the Council of the College. This medal has been conferred but eight times previously during the present century—on the last occasion on Sir Richard Owen.

Professor J. Mark Baldwin, of Princeton, has been awarded the gold medal offered by the Royal Academy of Science and Letters of Denmark for the best work on a general question in social ethics.

Dr. Karl Bohlin, of Upsala, Sweden, has has been appointed Astronomer to the Royal Academy of Sciences and Director of the Observatory at Stockholm.

At a meeting of the Royal College of Physicians, of London, on April 12th, Mr. Samuel Wilks, M.D., F.R.S., was re-elected President of the College. A portrait, by Sir Thomas Lawrence, of Sir Henry Halford, President of the College from 1820 to 1844, was received from the executors of his grandson, the late Sir Henry St. John Halford, who had bequeathed it to the College.

At the public exercises held on February 22d in honor of the twenty-first anniversary of the Johns Hopkins University, Professor Welch, on behalf of the friends and associates of Professor Newcomb, asked that he sit for a portrait to be given to the University. The remarks of Professor Welch as reported in the University *Circular* were as follows: "The custom which prevails in many foreign universities of celebrating, by some memorial, epochs in the lives of distinguished teachers and investigators connected with the university is one which can only be commended. A similar custom is finding increasing favor within recent years in this country, where so few material honors attend success in university and scientific careers. The colleagues and other friends of Professor

Newcomb desire to manifest their affectionate regard and their high appreciation of his services to science and to this University, and to mark an epoch in his life, by asking him to sit for a portrait to be painted in oil and presented to the Johns Hopkins University. It is just forty years since he left the work of a school teacher in the State of Maryland to engage in the mathematical service of the United States government. It is twenty years since he became senior professor of mathematics in the United States navy and editor of the *American Ephemeris and Nautical Almanac*. For many years he held the post of Astronomer in the Naval Observatory at Washington. With the Johns Hopkins University he has been closely associated since its foundation. He has been honored in unusual degree by academic distinctions and by election to membership in learned societies both in this country and Europe. His numerous contributions to science have received the highest possible recognition. This is not the occasion, nor am I the one, to attempt to estimate, in detail, the significance and the value of these contributions. The judgment of one's own peers is the test of the worth of discoveries in pure science. The great mathematician, Professor Cayley, has pointed out the rare combination, in Professor Newcomb's publications, of mathematical skill and power and of good, hard work devoted to the furtherance of mathematical science. When the blue ribbon of science, the Copley medal, was conferred upon our colleague by the Royal Society of London, attention was publicly called to the fact that he had won his distinction especially by his contributions to the science of gravitation and that his name was worthy to be remembered in the domain forever associated with the illustrious Isaac Newton. Professor Newcomb, your friends and colleagues now ask permission to place your portrait by the side of that of your colleague, Professor Gildersleeve, that thus there may be here silent and enduring tokens of the honor which this University bestows upon the man of letters and the man of science." Professor Newcomb responded briefly, acceding to this request.

WE recently expressed the hope that the valuable physiological library of the late Professor Du Bois-Reymond might be secured for an American institution. We now learn that Dr. Nicholas Senn has bought the library and has presented it to the Newberry Library of Chicago.

IT is stated that the widow of the late Professor Charcot has resigned the annual pension of 2,000 francs which she received from the State, in favor of other widows and children of professsors or *Agrégés* of the Faculty of Medicine of Paris who have died without leaving provision for their survivors.

PRINCETON UNIVERSITY will send its fourteenth geological expedition to the West during the coming summer. The party will be under the direction of Professor Scott and will make paleontological and geological studies and collections in South Dakota.

PROFESSOR LAWRENCE BRUNER, of the University of Nebraska, sailed April 27th for Buenos Ayres, where he will spend a year investigating the injurious locusts which have recently increased enormously in three of the eastern provinces of the Argentine Republic. Professor Bruner goes out under the employment of a commission of business men and bankers of Buenos Ayres, who have raised a large sum of money for the purpose of fighting the locusts, and who, very wisely, decided that the first step should be to engage an expert of great experience and acknowledged reputation. The commission applied to the United States Minister, Mr. W. I. Buchanan, and Mr. Buchanan wrote at once to Major H. E. Alvord, of the United States Department of Agriculture, asking him to consult with several of the directors of the agricultural experiment stations in the United States and to select the best-fitted person for the work. The committee at once chose Professor Bruner, who has secured a year's leave of absence from the University of Nebraska. No better choice could possibly have been made. Professor Bruner was connected with the U. S. Entomological Commission in its thorough investigations of the Rocky Mountain locust, or Colorado grasshopper, in 1876 to 1880, and has since become known as one of the foremost workers on the order of Orthoptera in the United States. He has de-

voted much time and attention to migratory species.

We regret to record the death of M. Lucien Biart, a French physician resident in Mexico, who made contributions to ethnology and natural history. The Paris Museum of Natural History contains botanical and ornithological collections made by him.

Mr. Otis E. Bullock died in New York from yellow fever on April 22d. He contracted this disease in Central America while on his way to make collections in natural history for the Frank Blake Webster Co., of Hyde Park.

President Mendenhall lectured before the National Geographical Society, Washington, on February 23d, his subject being 'Weighing the Earth.'

The Illinois Child Study Society will hold its third annual congress at Englewood, Chicago, from April 26th to May 1st. It will be presided over by Colonel Francis W. Parker, and addresses are expected from President G. Stanley Hall, Professor John Dewey, Professor William L. Bryan and other leaders in the movement for the scientific study of children.

The Canadian Electrical Association will meet at Niagara Falls, Ontario, on June 2d, 3d and 4th.

An Educational Museum will be opened at the State House, Boston, on May 1st. It will include the exhibits of the Massachusetts schools at the Columbian Exposition, together with the work of other schools, school appliances and a pedagogical library.

The *Astronomical Journal*, Cambridge, Mass., offers for sale several complete and partial sets of the *Journal*, founded by B. A. Gould in 1849, with an interruption from 1861 to 1885. The complete set is offered for $70, or without the first volume, which is very rare, for $55.

Dr. Walter Wenga will edit and A. Priber, Berlin, will publish a new journal, *Zeitschrift für Criminal-Anthropologie.*

A journal devoted to the applications of the X-rays to medicine and surgery, entitled *La radiographie*, has been established in Paris. It is edited by Dr. Paulin-Méry.

The Paris Municipal Council has voted $1,000 towards the cost of installation and maintenance of a skiagraphic laboratory at the Trousseau Hospital.

The French Chamber has allowed a sum of 297,000 francs for the payment of expenses incurred on account of defensive measures taken against the plague.

The Executive Council of the Massachusetts State Board of Trade, at a meeting on April 21st, passed the following resolution: "That the Board recognizes the great advantages which the general adoption of the metric system of weights and measures will promote, favors not only its general use and practice, but also endorses the bill now before the Congress of the United States which provides for the adoption of this system as the only system in the several departments of the United States government. And, further, that the Secretary of the Board inform the chairman of the Committee on Coinage, Weights and Measures of the vote of this Board."

President McKinley and Secretary Sherman have recommended that Congress make an appropriation of $350,000 for the representation of the United States at the Paris Exposition of 1900. Such provision will doubtless be made, and we hope that the example of Germany and other nations at the Chicago Exposition will be followed, and that scientific and educational matters will be well represented.

The Executive Committee of the Tennessee Centennial Exposition (which opens May 1st and continues six months) has petitioned the Board of Trustees of Vanderbilt University for the release of Dr. William L. Dudley, professor of chemistry, for the remainder of the present academic year, in order that they might engage his services. The University authorities granted the request, and the Centennial management has elected Dr. Dudley to the position of 'Director of Affairs,' giving him full charge of the executive management of the Exposition.

At a meeting of the Royal Botanical Society of London, on April 10th, the Secretary, Mr. J. B. Sowerby, gave an account of the cultivation and manufacture, into paper, of esparto grass, illustrating it by specimens and growing plants from the gardens. According to the report in the

London *Times*, the raw material is chiefly obtained from the north of Africa, Algiers being the center of distribution. The plant producing it, *Stipa tenacissima*, is capable of living under the most adverse conditions, being often found flourishing in the deserts in places where no other vegetable life can exist. It was suggested by the lecturer that this would be a most suitable plant by means of which the deserts of Sahara might not only be reclaimed, but turned into a source of profit. For many years past esparto grass has very largely superseded rags and similar substances in the manufacture of paper, and enormous quantities are annually imported to England for the purpose. Samples of paper made of esparto, in various stages of its manufacture, were shown by Mr. Layton, from the mills of Messrs. Weir, of Alloa, who consume over 7,000 tons of this material per annum.

SIR BENJAMIN STONE, M.P., has been in correspondence with the authorities of the British Museum on the subject of a proposal to establish a national photographic record collection. In a letter to the Board of Trustees of the British Museum, Sir Benjamin Stone offered for acceptance a series of 100 platinotype photographic views of Westminster Abbey, hoping that this would be the commencement of a national photographic record and survey collection to be under the direction and in charge of the British Museum authorities. In replying to Sir Benjamin Stone the Trustees state that they are in full agreement with him that such a record survey collection, if carefully and systematically brought together, cannot fail to be of the greatest value and interest both to the present and to future generations, and they are most willing to take charge of the photographs which from time to time may be deposited with them. It is proposed to form a preliminary committee to organize the work and to invite to act upon it, representatives of the Royal Society, the Society of Antiquaries, the Royal Photographic Society, the Royal Institute of British Architects, the Royal Archæological Institute, the Royal Geographical Society, the Trustees of the British Museum, and others. The Council of the Warwickshire Photographic Survey have promised a first contribution of 100 pictures of that county.

A COMMITTEE of the House of Commons, consisting of Sir E. Hamilton, Sir A. Godley and Mr. G. H. Murray has been appointed to inquire into the organization, pay and duties of the staff of the British Museum, including the system under which the staff is recruited and the reasons for or against competitive examination, either limited or otherwise; the classification, scale of salary, and hours of attendance required to insure the efficient and proper discharge of the duties of the establishment, and whether it is practicable to assign clerical and routine work wholly or in part to clerks of the second division; and, generally, any matters connected with the Museum establishment in regard to which they may be of opinion that alteration of existing regulations is desirable.

AN exhibition of agriculture and forestry will be held in Vienna by the Imperial and Royal Agricultural Society from May 7 to October 9, 1898. The following sections are intended to be of an international character: (1) Machinery and implements for agriculture and forestry. (2) Machinery and implements for agricultural industry. (3) Dairy machinery and appliances. (4) Fertilizers, feeding stuffs, and chemical products for agricultural and forest purposes. (5) Veterinary science. (6) Agricultural improvements, building and engineering. (7) Agricultural and forest education, research work, statistics and literature.

MR. C. T. HEYCOCK, F. R. S., lectured before the Royal Institution on April 8th on 'Metallic Alloys and the Theory of Solution.' According to the London *Times* the lecturer showed a number of experiments which established an analogy between the solution of a substance such as sugar in water and the solution of metals in each other. Just as the freezing point of a solution of a salt in water was lower than that of pure water, so the freezing point of a solution of a metal, such as thallium, in mercury was lower than that of pure mercury. After explaining that there was no essential difference between the two phenomena he stated that the remarkable theory of Van t'Hoff, to the effect that a substance in dilute solution existed within the liquid in a state resembling a gas, afforded the best clue to the interpreta-

tion of the results. This contention was supported by means of a table proving that the results arrived at by experiment agreed with those predicted by the theory. He showed that a weak solution of permanganate of potash when frozen yielded at first nothing but pure colorless ice, all the color, and hence all the salt in solution, becoming concentrated in the central unfrozen part. While seeking to establish that the same held true for the metals Mr. Neville and himself had hit on a method which he believed to be one of importance and which was shown that evening for the first time. Gold was very readily dissolved by metallic sodium, and if a solution of gold in sodium were allowed to solidify very slowly then sections cut from the solid alloy would appear perfectly uniform to the eye. If, however, the sections were placed on a photographic plate and exposed to the X-rays, on developing the plate a picture was obtained showing the actual structure of the solid alloy, the sodium being transparent to these rays, while the gold was opaque. By means of lantern slides sections were exhibited cut from sodium-gold alloys containing different percentages of gold. These sections showed that crystalline plates of sodium traversed the mass both horizontally and vertically, and that the gold, as the solution solidified, had become concentrated between the crystalline plates of sodium. The analogy between the solidification of an alloy and the solidification of an aqueous solution was thus established.

UNIVERSITY AND EDUCATIONAL NEWS.

THE will of the late Judge B. R. Shelden, of Rockford, Ill., bequeathes $100,000 to Williams College, $100,000 to the Hampton Institute and $10,000 to Rockford College.

IT is stated in the New York *Medical Record* that Dr. William H. Welch and Dr. William Osler, of the Johns Hopkins Medical School, of Baltimore, have declined the call extended to them by the University of New York, which has lately been consolidated with Bellevue Hospital.

PROFESSOR ALBERT BUSHNELL HART has been promoted to a full professorship of physics at Harvard University.

PROFESSOR W. F. EDWARDS has been elected President of the Washington University, Seattle, in the place of Dr. Mark W. Harrington.

DR. ANDR. LIPP has been appointed professor of analytical chemistry in the Polytechnic Institute at Munich. Professor Sissingle, of the Polytechnic Institute of Delft, has been called to the chair of physics in the University of Amsterdam, and Dr. George Scheffers, of Leipzig, to an assistant professorship of mathematics in the Polytechnic Institute in Darmstadt. Dr. Wülfing, docent in mineralogy at Tübingen, and Dr. Max Siegfried, docent in physiology at Leipzig, have been promoted to assistant professorships.

DISCUSSION AND CORRESPONDENCE.

THE RE-DISTRIBUTION OF TYPE-SPECIMENS IN MUSEUMS.

I CAN'T think why Mr. F. A. Lucas, in his most friendly review of my paper 'How may Museums best Retard the Advance of Science?' (SCIENCE, April 2, V., p. 543), should say: "Mr. Bather seems to use the term type a little vaguely, as one does not feel quite sure whether he means type or typical material." The term I used was 'type-specimen,' which has for me, and doubtless for Mr. Lucas, one meaning and one only. The question raised in my paper has been much discussed of late in England; permit me to put my view, which differs from that of Mr. Lucas, without satirical obscurity.

The object of museums is after all to advance and not to retard science. Take the case of a provincial museum, say at Thurso, in the extreme north of Scotland; suppose that this museum by some chance acquires a single specimen of a new Mexican beetle; suppose that some wandering 'Koleopterolog' from Germany chances on this and describes it in the *Zoologischer Anzeiger*. The specimen is now a type-specimen, "and no museum," says Mr. Lucas, "can afford to permanently part with these." But does the retention of this specimen at Thurso, in charge of some underpaid jack-of-all-trades curator, do anything

other than retard science? Would it not be better for all parties, including the museum and people of Thurso, if this priceless specimen were sent to Mexico, or to Washington, or to the Godman-Salvin collection in London, or even to Berlin, in exchange for a good teaching set of zoological specimens intelligible to the Thurso fisher-people?

This is a strong, though by no means an impossible case. Every specialist knows similar instances. Of what advantage was it to science that, when Dr. Otto Jaekel was writing his admirable memoir on the Devonian crinoids of Germany, all the type-specimens described by Schultze in his 'Echinodermen des Eifler Kalkes' were locked up in dusty boxes in a store room at Harvard? As things are, the type-specimens of any group of animals or plants, whether a zoological group, a geographical group, or a stratigraphical group, will be found by the specialist scattered all over the world without reference to country or to facilities for study. And we museum curators go on adding to this confusion as hard as ever we can, with the aid of preliminary notices, and stretch miserly hands over specimens that are wanted most in some center of research 8,000 miles away. We advance our museums, but we retard science.

And yet there are some of us who are also students and lovers of science. We wish to use our powers for her advancement. This we think might be done partly by the collection of the type-specimens of a single group in a single museum, partly by the restoration of type-specimens to the country of their origin, provided that it possessed a museum capable of preserving them unharmed, partly by the withdrawal of type-specimens from small local museums where they 'waste their sweetness, etc.,' and are far from safe, to the larger museums with permanent endowment. We do not wish any museum to suffer; exchange is no robbery, and in this case might be as much gain to each contracting party as it would be to scientific investigators.

Another small point in Mr. Lucas' notice provokes an explanation. "On the question of loaning specimens," says he, "Mr. Bather dwells lightly, owing to his connection with the British Museum, whose policy in this respect is well known." This is Mr. Lucas' reason, not mine. My view is that type-specimens should not be lent (they should, if necessary, be exchanged); but other material should be lent freely to responsible workers. There is always a danger of loss; but, while the lost type-specimen can never be replaced, the gain to the museum and to science through the study and description of ordinary specimens more than counterbalance the occasional loss of one. This is not the policy of the British Museum, and no remarks of mine are likely to make it so. Similarly my opinions will not prevent me from borrowing type-specimens of crinoids from any museum rash enough to lend them to me.

F. A. BATHER.

BRITISH MUSEUM (NAT. HIST.), April 15, 1897.

THE QUATERNARY OF MISSOURI.

TO THE EDITOR OF SCIENCE: After reading the quite satisfactory review of my report on the Quaternary of Missouri, in your issue of April 9th, some unanswered questions were left in my mind. As the answers may be of interest to others I venture to offer them through your columns. Mr. Hershey suggests that the idea that the *loess* 'area deposited by broad semilacustrine stream floods,' 'would not have originated upon certain other areas, for instance, the upper Mississippi region.' Is not this virtually the origin conceived the most probable for the loess of the 'Driftless Area' by Chamberlin and Salisbury in the 6th Annual Report, U. S. Geol. Survey?

Mr. Hershey, if I understood rightly, suggests that the loess deposits of Missouri and of southern Illinois as well as of the upper Mississippi were formed in a vast lake or arm of the sea. If that be the case I would ask (1) why no traces of beach ridges have been preserved anywhere, and (2) how he would account for the absence of loess from surfaces along the Mississippi below the supposed 'barrier' much lower than the general level of the loess northwest of that 'barrier,' viz., the Osage Gasconade divide?

If I had been able to find beach ridges and been able to make the margin of the loess south of the Missouri river pass easily into that west

of the Mississippi I should have been only too ready to accept the lacustrine hypothesis.

J. E. Todd.

A 'DRIFTLESS' RIDGE.

To the Editor of Science: In reviewing, in the April 9th number of your journal, Professor Todd's report on the quaternary geology of Missouri, I mentioned a certain 'driftless' ridge in Pike and Calhoun counties, in Illinois, and referred its study to Mr. Frank Leverett. My attention has been called to the fact that the driftless nature of this ridge was discovered by Professor R. D. Salisbury (see Proc. A. A. A. S., Washington meeting, 1891, pp. 251–253), and that its study was largely accomplished by him.

In reference to the sections of the old and new gorges of the Mississippi river, between Montrose and Keokuk, Iowa, I wish to add to what I have said previously, that they were published through the courtesy of the Iowa Geological Survey, to which institution their preparation should be credited.

O. H. Hershey.

SCIENTIFIC LITERATURE.

Diseases of Plants Induced by Cryptogamic Parasites. An Introduction to the Study of Pathogenic Fungi, Slime-Fungi, Bacteria and Algae. By Dr. Karl Freiherr von Tubeuf. English edition by William G. Smith. Longmans, Green & Co., London, New York and Bombay. 1897.

The German edition of this work appeared in 1895 and was the first attempt at a comprehensive treatment of the diseases of plants caused by parasites of the class Thallophyta, chiefly parasitic fungi. Such a work has been long needed, but there have been many difficulties in the way of the successful preparation of it. The fact that many of the diseases were but little known, that the organism causing them had been but little studied, and that important contributions were constantly being made to our knowledge of these forms, made it exceedingly difficult to get a book of such dimensions through the press before important changes would be necessary in order that it should properly represent the then status of the subject. While the German edition when it appeared was welcomed because of the mass of information which was here for the first time brought together in a single book, it was notable for some important omissions, especially of work done in the United States. This was probably due in part to the fact that some of the investigations had not come to the notice of the author, and partly to a failure on his part during the press of the work to consult the American journals like the *Botanical Gazette* and the *Bulletin of the Torrey Botanical Club.* While it is evident there was no intent on the part of the author to ignore American work, the edition would have been more valuable had a little more time been given to investigations of this portion of the literature of the subject. Since, however, the work was intended primarily for the German-speaking people there is here some partial defence of the omissions.

The chief difficulty, however, that of keeping the work up to date while going through the press, was, from the very nature of the state of our knowledge of these subjects, an insurmountable one. This is forcibly illustrated in the fact that in the English edition, which appears within two years after the first edition, it was necessary to recast and rewrite the whole portion of the book which treats of the family Exoascese and the genus *Gymnosporangium*, so rapidly have investigations in these groups followed each other, and so greatly have the limitations of species been changed by a study of the physiological effects on the hosts on the one hand and of biological studies on the other.

In the preparation of the English edition the author, Dr. von Tubeuf, privatdocent in the University of Munich, has added much that was omitted from the first edition and has rewritten the sections already alluded to above. The English translator, William G. Smith, lecturer on plant physiology in the University of Edinburgh, has also assisted in enhancing the value of the work in some additions for which he alone is responsible. It is not often that an author is so fortunate in the selection of his translator as Dr. v. Tubeuf has been. Dr. Smith was at one time a pupil of the author in the laboratory of the University of Munich, and at the very time when the book was being prepared for the first edition, so that he was

familiar with its general plan and with the spirit of the author.

In looking over the bibliography, which includes the more important works consulted by the author and translator, it is interesting to note that the bulletins of the experiment stations in the United States have been given a place, and there are many references in the body of the work to the published investigations of several of these stations.

In defining the parasitism of the parasitic fungi, on account of the facultative nature of a large number of the species of both parasitic and saprophytic forms, the author believes that it is more correct to consider as parasites those which in their attack respond to the stimuli exerted upon them by living plant cells rather than as an adaptation to nutrition, being influenced in this respect by the researches of Pfeffer and Miyoshi. According to these investigations the stimulus seems to be a purely chemical one, and Miyoshi has shown that ordinary saprophytic fungi, as *Penicillium glaucum*, may be made to behave like a parasite by injecting a two per cent. solution of cane sugar into leaves.

The terminology applied to those forms which are not strictly obligate parasites or saprophytes is different from that employed by de Bary and others, the present author employing the terms 'hemi-parasites' and 'hemi-saprophytes.' The first chapter further deals with the mode of life of the parasitic fungi, their relation to the host and to its different tissues, and the various modifications of the mycelium into absorbent organs for the taking up of nutritive matters.

In the chapter on the reaction of the host to parasitic attack the work treats of the absorption of cell contents, the absorption of cells and tissues (notably in certain Ustilagineæ), the killing of host cells and tissues by ferments, the killing of organs or entire parts, the premature development of buds, preservation of the host plant, arrest of growth, atrophy, hypertrophy, and changes in cell contents of the host. Under the last head among other things is cited a kind of chlorosis produced by certain fungi on the host, when the green parts become bleached and lose their green color, as in the case of the attack of many of the Exoascese. This is termed 'mycetogenous chlorosis.' Contrasted with this are those cases which have probably been observed by all students of parasitic fungi, in which the affected portions of the leaves or shoots remain green longer, while the unaffected parts become pale and lose their green color. A third case is termed 'mycetogenous chloranthy,' that is the development of green color in the floral parts, as in the petals and stamens of *Brassica nigra* and *Sisymbrium pannonicum* attacked by *Cystopus* and *Peronospora*, and in the flowers of *Anemone ranunculoides* attacked by *Æcidium punctatum*. In some cases of hypertrophy the cell sap assumes a rose color on the sunny side, as in galls, caused by Exobasidium and in the bracts of the catkins of alder attacked by Exoascus. Carmine and yellow colors also occur, and yellow color may sometimes result from the yellow oil contents of the mycelium lying in the tissues. The accumulation of starch in parts of the host attacked by certain fungi is noted, as in the spruce needles when affected by *Lophodermium macrospermum* at a time when it is only being slowly formed in unaffected needles. Starch preservation is noted in oak wood destroyed by two fungi simultaneously. This chapter further deals with the effect of the mycelium in dissolving starch grains, wood cell walls and the effects of fungi on the anatomical structure of their hosts.

Under 'mutualism' or 'symbiosis' in the stricter sense the author first cites the much discussed case of the lichens. Here, the author claims, "as a result of the union of fungus and alga, a living organism originates, which in form necessities, and mode of life is quite new, and differs completely from either of its components." In dilating upon the evolution of this new organism the author compares it with water, which is the result of the combination of oxygen and hydrogen, or to a certain extent to the new individual, which is produced by the union of sexual cells. "These and other examples," he says, "will serve to illustrate how we have in the lichen an organism with peculiarities of structure and of life widely differing from those of either an alga or a fungus." This unification of two living beings into an individual whole the author terms 'individuation'

(individualismus). While there are a number of lichenologists at the present day who accept this theory of the lichen, which has been elaborated farther by Reinke, it should be understood that there are others who are not convinced by the 'relentless' logic which separates the lichen fungi as a distinct class, but who look upon this relation of fungus and alga as parasitism in which the fungus is no more dependent on the alga than are certain other fungi upon their hosts. In the perennial parasitic Exoasceæ, for example, the affected parts of the host in the case of such species as *Exoascus deformans*, *E. pruni*, etc., are totally unlike the normal parts of the host, and during their existence, in 'form, necessities and mode of life, differ completely from either of their components.' This deformed structure differs from the lichen only in the fact that the entire host is not a changed and 'new' being. But here there is no necessity for this, since the host is a bulky, multicellular structure, while the alga which is associated with the fungus is often an unicellular organism, or one of a few cells, or at most in a few cases a comparatively complex organism of small size, so that it could not afford a sufficient amount of nutrition for the fungus unless woven in close connection with the fungus threads.

The author recognizes that the same kind of 'individuation' which is manifested in the lichens also exists in the modified structure brought about by the parasitism of many of the fungi when he cites the negative geotropism characteristic of witches' brooms, since the new growth is no longer controlled by the same laws of growth as the normal lateral branches. Further, he points out that this structure possesses other characteristics not exhibited by normal plants when the witches' broom of the silver fir casts its needles each year. In other cases they bear no flowers or fruit. "From these facts it can be deduced that parts of plants attacked by fungi exhibit that kind of symbiosis with the fungus which we call individuation, the joint community behaving more or less as a parasite on the stem or branches of the host plant. This is clearly the case where the attacked parts exhibit increased growth, and at the same time a diminished production of chlorophyll resulting from degeneration of chloroplasts. Such parts of plants are quite as individualized as the lichens, with the single distinction that they remain in communication with the parent plant and draw nourishment from it."

From this it would seem reasonable to conclude that if the fungi which attack algæ are to be placed in a separate class because of this individualized condition, as some contend, these 'individualized' parts of vascular plants should be separated as another class of organisms. We do not understand, however, from his discussion that the author sanctions the separation of the lichen fungus from other fungi as a distinct class rather than on the ground of convenience. It has been a matter of convenience as well as one of taste to study and publish the lichens separately, just as it is often a matter of convenience to separate the parasitic fungi from others. But neither matters of convenience, nor taste, nor continued dependence upon some other organism and physiological amalgamation with it for limited periods, should be the ruling principle in natural taxonomy.

The word 'individuation' (individualismus) is misleading, unless the author means by it that the lichen has become a being with individual traits as distinct as those beings which are recognized as individuals. If this latter interpretation is given it would seem to violate one of the fundamental criteria of an individual being, namely, that in reproduction it must pass through the one-cell stage, while the lichen thallus is never originated by less than two cells.

The author uses the term nutricism to denote the 'symbiotic' relation of 'mycorhiza' to their hosts, as exampled in the case of Monotropa and the filamentous fungus covering its roots, the mycodomatia of the alder, the legumes, orchids, etc. These general topics make up the first part of the book and cover about 100 pages.

The second part covers over 400 pages and treats first of the pathogenic fungi and lastly of the pathogenic algæ.

The fungi are taken up in the following order: Chytridiaceæ, Zygomycetes, Oomycetes, Ascomycetes, Ustilagineæ, Uredineæ, Basidiomycetes. Then follow the 'Fungi Imperfecti.' The discussion of each genus is preceded by a

description of its principal characters: A few of the important species in each genus are quite fully described and in many cases illustrated. These are followed by a further enumeration of a number of other species with their hosts and localities, the species in many cases for Britain and the United States being indicated.

The book is very fully illustrated, a very large number of the illustrations being new, either from the pencil of the author or from excellent photographs. As foot notes, there are very copious references to works even in cases where space would not permit of a discussion of their contents.

Neither the author nor the translator pretends to completeness, but modestly offer excuses for faults which under the conditions could not be well avoided. These can well be overlooked in view of the great amount of information contained in the volume which will prove to be a very useful adjunct to reference works on parasitic fungi. When a new German edition shall be called for the author promises to thoroughly revise it and expresses the wish that those who have in the past sent him copies of their investigations continue to do so in order that he may make this edition as complete as possible.

GEO. F. ATKINSON.
CORNELL UNIVERSITY.

RECENT BOOKS ON QUATERNIONS.

1. *Theorie der Quaternionen.* VON DR. P. MOLENBROEK. Leiden, E. J. Brill. 1891. Pp. vii+284.
2. *Anwendung der Quaternionen auf die Geometrie.* By the same author. 1893. Pp. xv+257.
3. *The Outlines of Quaternions.* By. LIEUT.-COL. H. W. L. HIME. London, Longmans & Co. 1894. Pp. 190.
4. *A Primer of Quaternions.* By A. S. HATHAWAY. New York, Macmillan & Co. 1896. Pp. x+113.
5. *Utility of Quaternions in Physics.* By A. MCAULAY. Macmillan & Co. 1893. Pp. xiv +107.

The above books are all contributions to the literature of the Quaternion side of space-analysis. The first, by Dr. Molenbroek, is a carefully written exposition of Hamilton's theory; the author, if he does not examine the correspondence of the theory with exact science and established analysis, at least presents it so as to be internally consistent. For instance, he explains the fundamental rule $ij = k$ as meaning that a quadrant round the axis j followed by a quadrant round the axis i is equivalent to a quadrant round the axis k. Consistently with this, he explains the rule $i^2 = -1$ as meaning that a quadrant round the axis i followed by a quadrant round the same axis is equivalent to a reversal. The treatise, however, does not go deep enough; for the subject of quaternion logarithms and exponentials is embraced in a 9-page appendix, and what is there given is the well-known theory of coplanar exponentials. It is only when diplanar exponentials are handled that problems can be attacked which are insoluble, or at least not readily solved by the ordinary methods of analysis. Dr. Molenbroek introduces an indefinite use of $\sqrt{-1}$ to signify a quadrant round some axis perpendicular to a given line. There are reasons for believing that in space-analysis $\sqrt{-1}$ is scalar in its nature, and that it distinguishes the hyperbolic angle from the circular angle. Anyhow, that is one definite meaning.

The third book, by Col. Hime, presents a very dim and imperfect outline, which it would be well for the beginner to avoid. By perusing it he may get his ideas confused, not only of analysis, but of mechanics; for example, at p. 33 the terms 'version,' 'torsion,' 'rotation,' 'twist,' are all used as synonymous. This is, at least, awkward, for one of the first things which a student of quaternions must do is to distinguish between the trigonometrical composition of angles and the mechanical composition of rotations. The author explains the rule $ij = k$ by saying that j and k each signify a unit vector, but i signifies a quadrantal versor which turns j into k. But he fails to observe that this explanation cannot apply to the complementary rule $i^2 = -1$, for a quadrantal versor i operating on a unit vector i would leave it i. Chapter Tenth is devoted to the 'Interpretation of Quaternion Expressions;' thus for nine chapters the reader is supposed to be dealing with symbolical expressions. Would it not be

better if the real meaning of each expression were clear from the beginning?

The fourth book, by Professor Hathaway, presents a much better introduction to the method, and the student who masters it will find that he has acquired some real knowledge, not merely additional dexterity in formal manipulations. The exposition, as a matter of logic and of truth, is not all that can be desired, for it is based partly on formal laws, partly on mechanical truths. For example, the principle that the addition of vectors is associative is made to depend on an arbitrary definition of the equality of vectors, but the same principle for the product of quaternions is rested upon the composition of rotations of a rigid body.

The fifth book, by Mr. McAulay, has a different purpose from that of the others. It is an essay, not an introduction or a treatise, and the aim of the essay is to make good the following statements: First, that Quaternions are in such a stage of development as already to justify the practically complete banishment of Cartesian geometry from physical questions of a general nature; and second, that Quaternions will in physics produce many new results that cannot be produced by the rival and older theory. In the essay the author applies the quaternion analysis to the theories of elastic solids, electricity and magnetism and hydrodynamics. It is almost wholly a translation into quaternion notation of known results; the author has, however, endeavored to advance each of the theories mentioned in at least one direction.

It is evident that the utility of a method is best proved not by any essay, but by its extensive and fruitful use. How does it come about that the method of quaternions is so far from general and accepted use that it is still the subject of debate, misunderstanding and even ridicule? Not a few mathematicians agree with the opinion expressed by a German mathematician, that it is an aberration of the human intellect. The answer to the above question I believe to be as follows:

In the books before us, and, indeed, in all the works by members of the old school, it is admitted, even proclaimed, that the Hamiltonian analysis is a rival of the Cartesian analysis. Mr. McAulay talks of it as a new plant, independent of the old tree of analysis; and in their letter to SCIENCE proposing an international association Dr. Molenbroek and Mr. Kimura invited mathematicians to leave the old domain of Cartesian analysis. Now, when one who has been trained in the Cartesian analysis approaches the new method he finds that the notation is strange and the conventions contradictory of those to which he has been accustomed; consequently, he concludes, as David did about Saul's armor, that it is better in actual warfare to rely on a familiar weapon than on one which may be superior but is unproved.

What is the true relation of space-analysis to the Cartesian analysis? The quaternionist makes them rivals; there is the blunder. Space-analysis can be presented so as not to contradict or rival the Cartesian analysis, but, on the contrary, be consistent with and supplementary to it. The relation of the former to the latter is like that of algebra to arithmetic. Algebra is universal arithmetic; so space-analysis is universal Cartesian analysis; that is, it considers the properties of vectors which are independent of coordinates. Many theorems are readily proved by algebra which it would be difficult, if not impossible, to prove by arithmetic; similarly, many theorems can be readily proved by space-analysis which it is difficult, if not impossible, to prove by means of coordinates. If we wish numerical results, coordinates must be introduced, just as, if we wish numerical results, numbers must be introduced into the formula furnished by algebra.

Some writers express the opinion that agreement about notation is all that is required in order to render space-analysis generally accepted. But it appears to me that the difficulty is more deep-seated; the fundamental principles need to be discussed, and no notation can be adequate and lasting which is not built on the simplest and truest principles. I may mention briefly some points of principle which have to be settled.

It is unscientific to base the analysis partly on formal laws, partly on physical principles. By not distinguishing between simultaneous and successive addition Hamilton failed to discover the true generalization for space of the

exponential theorem. I have demonstrated that in space $e^p \times e^q = e^{p+q}$, and the demonstration shows conclusively that the Hamiltonian ideas about the addition of vectors require to be revised. Although I have asked quaternionists to point out any error in the demonstration, no error has been pointed out.

The Hamiltonian principle that a unit-vector may be identified with a quadrantal versor requires to be modified. The conception of a line does not involve the idea of an angle, whereas the conception of an angle involves the idea of two lines. The question reduces to the following: Can a line be conceived apart from an initial line? The answer appears to be yes, for Hamilton did not succeed in his endeavors to extend algebra to space until he abandoned the idea of an initial line and considered all three axes as equally real. The vector and the versor are complementary ideas, and just as a vector is expressed in terms of rectangular coordinates which are in their nature vectors, so a versor is expressed in terms of rectangular quadrantal coordinates which are in their nature versors.

On the other hand, a vector cannot take the place of the versor. To ignore the versor and more generally the quaternion is the mistake made by writers who confine space-analysis to vector-analysis, which is merely a branch. The very name vector-analysis implies a restricted view of space-analysis. The versor is the proper idea in spherical trigonometrical analysis, and in a modified form expresses the rotation of a rigid body. It leads up to higher ideas which express elliptic and hyperbolic angles and the motion of a body which is not rigid.

In mathematical analysis the product of two quantities having the same direction is positive, while that of two quantities having opposite directions is negative; consequently the square of a quantity is always positive. Consistent with this the reciprocal of a negative quantity is the negative of the reciprocal. Now, are all the quantities considered in algebra or the Cartesian analysis scalar quantities, or are they in some cases partial vectors? If in any case they are partial vectors (that is, component of a vector) then, in order to be consistent, the square of a vector in space must be positive and the reciprocal of a vector have the same direction as the vector.

The order of writing of the terms of a sum or the factors of a product should conform, as far as possible, to the order followed in mathematical analysis. There the natural order of writing is followed, from left to right, and, as in a determinant, from top to bottom. But in books on Quaternions, for example, Hathaway's Primer, p. 49, we have the Hebrew order of writing. This abnormal order of writing was adopted from the idea that a product of quaternions supposed an operand and that the operand ought to be on the right. As a matter of fact, in the expression for the rotation of a versor the operator is written both before and behind.

ALEXANDER MACFARLANE.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, APRIL–MAY.

PROFESSOR CHAMBERLIN continues his glacial studies in Greenland, giving a description of the Bowdoin glacier. This is a tongue of the great inland ice-cap which descends from the north into the head of Bowdoin Bay. On the west it is confluent with the Tuktoo and Sun glaciers. The Bowdoin glacier has a length of six or eight, and in its lower part a breadth of about two miles. It has a descent of 2,000 to 3,000 feet, and is notably crevassed. It discharges icebergs of considerable dimensions, the discharge varying greatly with the season. The west side does not present the usual vertical scarp, and this is thought to be due to the fact that the ground which should act as a reflecting plane is covered by protuberances from the Tuktoo glacier. The stratification and basal loading of the ice is much the same as in the glaciers previously described, though the débris does not rise so high. The bowlders were usually more rounded, and this rounding is of such a nature as to imply very considerable wear. This considerable rounding, the small amount of débris and its low position in the ice are especially significant in view of the fact that the Bowdoin is one of the larger tongues of the great icecap.

Dr. Henry Washington describes the Rocca Monfino region in the fourth of his Italian

Petrological Sketches. The rocks of the region belong to three periods of activity: (1) the leucitic characterized by leucites and leucite-tephrites, (2) the trachytic and (3) the basaltic. Among the rocks of the first period is a biotite-vulsinite, a rock intermediate between the trachytes and andesites. The silica is lower than in the vulsinites, the lime, iron and magnesia very much higher and the alkalies considerably lower. Chemically the rock is almost identical with ciminite, but in deference to the present mineralogical classification of rocks it is put with the vulsinites.

Are the Bowlder Clays of the Great Plains marine? is asked by Dr. George M. Dawson, and as a reason for the question he enumerates several species of foraminifera, in part modern forms, determined from the Canadian bowlder clays by Mr. Joseph Wright.

The Beauxite deposits of Arkansas are described by Professor John C. Branner. The beauxite deposits were discovered by the recent Geological Survey of that State and are of ferruginous, earthy and kaolin-like varieties with pisolitic structure. In age they probably belong to the Tertiary. They appear to have been laid down in water near the shore and, in part at least, to have been uncovered at low tide or broken up by storm waves, rolled, and finally left at or near where the material had originally lain. In the opinion of Professor Branner, before the eruptive syenites had cooled they were sunk beneath the Tertiary sea, and either by the contact of the sea water or the issuing of springs, whose waters had been in contact with the hot syenites, the aluminous materials were segregated as pisolite and sank near where they were formed. The beds have not been developed, though they could be used to advantage as a refractory material in the manufacture of iron and steel. The paper includes a considerable bibliography.

H. F. B.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY, APRIL 19, 1897.

THE evening of the monthly meeting of the Section was devoted to a reception, by the whole Academy, to Sir Archibald Geikie, Director-General of H. M. Geological Survey of Great Britain, who had just returned to this country for a brief visit after an absence of eighteen years. After an informal reception the meeting was called to order and addressed briefly by the President of the Academy, Professor J. J. Stevenson, who extended a most hearty welcome from the scientists of New York to the guest of the evening. Professor Stevenson was followed by Professor J. F. Kemp, the Chairman of the Section, who reviewed in a few words the greater contributions of Sir Archibald Geikie to the cause of geology. He spoke of his early work in Scotland, in France and in the western United States in the study of vulcanism, and paid particular attention to the work that had been done in Scotland on the metamorphic rocks. Professor Kemp concluded with a tribute to Sir Archibald as a naturalist, and spoke of the superior quality of work that is given the world by the man who is in love with nature and finds in the solitude of the wildness of nature his greatest company and inspiration.

The next speaker was the Secretary of the Section, who spoke particularly of the work of Sir Archibald Geikie as looked at from the standpoint of the teacher and physiographer. He reviewed hastily the character and quality of Geikie's Text-book and Class-book of Geology, and spoke more especially of the example this distinguished geologist has set in physiography in the masterly analysis of the physical features of Scotland given in his Scenery of Scotland.

The last address of welcome was given by Professor Angelo Heilprin, of Philadelphia, who spoke as a traveler and contrasted the knowledge of the geology of the world now with our knowledge at the time of Humboldt. He spoke of how much we owed to the guest we were welcoming for his work in bringing together the shreds of knowledge from all parts of the world and in building up a great mass of geological information, which is a vast help to all workers in geology and a stimulus to all.

In reply Sir Archibald Geikie expressed his thanks to the Academy for the very cordial reception that had been tendered him in New York. He contrasted the appearance of the

city eighteen years ago and now, and spoke of the great growth of New York vertically as well as horizontally. He paid a brief word of tribute to his friends of his former visit, particularly Newberry, Leidy, Dana, Cope and Hayden, whose help and good will have ever been a great inspiration to him.

In reviewing the work of world-wide reputation that the American geologists are producing, Sir Archibald Geikie paid a warm tribute to their industry, their perseverance, their breadth and their scientific acuteness. He contrasted, in a very favorable way to the United States, the policy of the British and United States governments in regard to the printing, publishing and distribution of government reports.

After these brief addresses an opportunity was given for meeting the guest of the evening, for personal social meetings among the members of the Academy, and for greeting the guests from a distance, including several well-known geologists.

RICHARD E. DODGE,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met February 17th; seventy-three persons present.

Professor N. S. Shaler spoke of the subterranean water of southeastern New England, stating briefly the distribution of earth water, the characters of the superficial deposits, and of the supply yielded by the deeper rocks. In America the bed rocks yield but little water, a case of supply being unknown. Good water depends upon the length of time the rocks have had to decay; it is obtained from the uncompacted rocks and from drift deposits; in Massachusetts the supply from the latter rarely fails. Wells that penetrate into preglacial deposits are largely charged with iron and seldom furnish good water. The till or boulder clay gives good water, except where lime abounds; the water-holding power of these clays is, however, small. Sand plains are favorable for a good water-supply. Professor Shaler gave a detailed description of the sources of the water-supply of southeastern Massachusetts, especially of that of Martha's Vineyard, and in closing said that the desire for pure water was increasing and would shortly be a demand. Boston, from its proximity to the Bristol, Plymouth and Cape sand plains, is favorably situated for an abundant supply, and a reservation of 10,000 acres in the region mentioned would be a benefaction for future generations.

Dr. C. R. Eastman prefaced his paper on some Devonian bone- and fish-beds of North America with an account of the difficulties encountered in the study of fossil fishes, owing to the imperfectness of the material and the lack of systematic exploration. He discussed the structure of *Coccosteus* and described remains of lung-fishes that simulate shark's teeth, found in the Devonian of Iowa.

At the meeting on March 3d sixty-five persons were present. Mr. T. A. Jaggar, Jr., gave an account of his experimental studies of mountain building, illustrating his remarks with a series of models. The scope of geological experimentation was explained, and the conditions under which rocks fracture, the determinant of flexibility and the influence of initial dip noted. A most interesting experiment shows deformation at both ends; the opposite direction of thrusts shows on one side only; the ratio of force to resistance is not influenced by the scale. Mr. J. B. Woodworth remarked upon the geology of the Gay Head Cliff, describing briefly the geological characteristics of the New England group of islands, and giving a detailed account of the formation studied at Gay Head.

A general meeting was held on March 17th; ninety-three persons were present. Mr. Frank Russell gave an account, illustrated by lantern views, of his two years' voyage down the Mackenzie, sketching briefly the characters of the surrounding country and describing with some detail the difficulties that arose owing to the customs and traditions of the Dog-rib Indians. Some of the customs of the Eskimos were noted, also the natural history of the musk ox, Barren ground caribou and bison.

SAMUEL HENSHAW,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

THE regular monthly meeting of the Texas Academy of Science was held on the evening of April 2d.

A paper on 'Experiments with X-Rays on the Blind' was read by Dr. H. L. Hilgartner, oculist to the State Institution for the Blind. This contribution is the joint production of Dr. Hilgartner and Professor E. F. Northrup, of the chair of physics in the University. As the authors state, the experiments were stimulated by the extraordinary claims made by Dr. Louis Bell in a letter to the editor of the *Electric World* (December 12, 1896), in which it was maintained that a man totally blind from paralysis of the optic nerve was able to distinguish the flickering of a Crook's tube. This the authors wished to verify or disprove. As to their apparatus they say: "The outfit employed in our test is of the best. A double focus tube is excited by a Tesla coil capable of giving an eight-inch discharge. The X-Rays produced will show a shadow of the hand upon the fluorescent screen at a distance of twenty-five or thirty feet." Of the eleven persons experimented upon, seven had no light perception; they were suffering from atrophy of the optic nerve. Of the four having some light perception, three were blind from affections of the cornea and lens, and one from atrophy of the optic nerve. After describing their experiments the authors give as their conclusion "that the X-Rays themselves have no power whatever of exciting vision or even light perception in any kind of an eye, diseased or normal. Of course, these results regarding the blind apply only to the eleven subjects experimented upon, and it would be unscientific to say that no subject can ever be found in whom the X-Rays will excite light sensations. None of the blind subjects could see anything by looking into the fluoroscope, even those having some light perception getting no sensation, and our experiments gave us no hint that the X-Rays, or any other kind of rays, proceeding from the Crook's tube are able to give any light perception to those who are totally blind from any cause whatever." * * * * * * *

"We should not have thought the above negative results worthy of record if the matter had not been taken up by scientists of eminence and the newspapers filled with trashy and misleading myths."

Mr. J. R. Bailey gave an account of his investigations of the Hydrazine Derivatives of Propionic Acid, being a continuation of his studies begun more than a year ago in the laboratory of Professor Thiele at Munich.

A paper by Mr. M. B. Porter, now of Harvard University, 'On the Roots of Bessel's Functions,' was announced by title.

Frederic W. Simonds.
University of Texas.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis, held on the 19th of April, 1897, twenty-one persons present. Dr. C. Barck delivered an address on Helmholtz—his life and work; and Dr. C. R. Keyes, the State Geologist of Missouri, presented papers on the relations of the Devonian and Carboniferous systems of the upper Mississippi basin and the distribution of Missouri coals.

William Trelease,
Secretary.

NEW BOOKS.

The Ancient Volcanoes of Great Britain. Sir Archibald Geikie. London and New York, the Macmillan Co. 1897. Vol. I., pp. xxiv +477, Vol. II., pp. xv+492. $11.25.

The Theory of Electricity and Magnetism. Arthur Gordon Webster. London and New York, the Macmillan Co. Pp. x+576. $350.

Elements of Astronomy. Sir Robert Stawell Ball. London, New York and Bombay, Longmans, Green & Co. 1896. Pp. xvi+469.

Numerical Problems in Plane Geometry with Metric and Logarithmic Tables. J. C. Estell. New York, London and Bombay, Longmans, Green & Co. 1897. Pp. vii+144.

Topics and References in American History, with Numerous Search Questions. George A. Williams. Syracuse, N. Y., C. W. Bardeen. 1897. Pp. viii+176. $1.00.

ERRATA: P. 591, col. 1, line 42 and col. 2, lines 14 and 29 for *Puppis* read ζ *Puppis*. P. 592, col. 2, line 36 for March 19th read March 26th.

Very truly yours

E. D. Cope.

SCIENCE

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FRIDAY, MAY 7, 1897.

CONTENTS:

Edward D. Cope: HENRY F. OSBORN.....705
Psychology and Comparative Psychology: WESLEY MILLS.....718
Pareiasauria Seeley (Cotylosauria Cope) from the Triassic of Germany: G. BAUR.....720
Current Notes on Physiography:—
McGee on Sheetflood Erosion; Relief Map of New Jersey; Moraines of the Missouri Coteau; Notes: W. M. DAVIS.....722
Current Notes on Anthropology:—
The Monoliths of Tafi; Ethnography of the Myceneans: D. G. BRINTON.....724
Notes on Inorganic Chemistry: J. L. H.....725
Astrophysical Notes: E. B. F.....726
Scientific Notes and News.....727
University and Educational News.....731
Discussion and Correspondence:—
Type Specimens in Natural History: C. HART MERRIAM.....731
Scientific Literature:—
Spencer's Principles of Sociology; Le Bon on The Crowd: FRANKLIN H. GIDDINGS. *Setchell's Laboratory Practice for Beginners in Botany:* L. M. UNDERWOOD. *Hannequin's Essai critique sur l'hypothèse des atomes dans la science contemporaine:* E. A. STRONG.....732
Scientific Journals:—
The American Journal of Science; The Auk.....738
Societies and Academies:—
The Biological Society of Washington: F. A. LUCAS. *The New York Section of the American Chemical Society:* DURAND WOODMAN.....739

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

EDWARD D. COPE.

NATURAL science and philosophy have sustained a heavy loss in the premature death of Professor Edward D. Cope. His work began at a most favorable time, in 1859, when comparative anatomy first felt the impetus of the 'Origin of Species,' and for thirty-eight years his active mind has been hastening our progress in no less than five great lines of research. In each his inspiring example and leadership will be sadly missed. He passed away upon April 12th, at the age of fifty-seven, in the full vigor of his intellectual powers, leaving a large part of his work incomplete. Almost at the last he contributed several reviews to the *Naturalist*, and upon the Tuesday preceding his death he sent to the press an elaborate outline of his University lectures containing his latest ideas of the classification of the Vertebrata. For two months his health had been affected by a serious disorder, which might possibly have been remedied by a surgical operation. This was unfortunately postponed until it was too late, and the end came so suddenly that his family decided not to remove him from his house, in Pine Street, which was both his study and museum. He thus passed away in the scene of his life work, surrounded by his fossils and books. A gathering of his scientific friends in his memory also took place here a few days later. His will proves to be consistent with his life, as he leaves

all his rare scientific treasures for the benefit of the Philadelphia Academy of Sciences and the University of Pennsylvania. It is hoped that the following sketch of his early life and brief review of his principal writings will give some idea of his genius and of his position in the world of science.

Edward Drinker Cope was born in Philadelphia, July 28, 1840, of distinguished American ancestry.* His great-grandfather, Caleb Cope, is said to have been the staunch Quaker of Lancaster, Pa., who protected Major Andre from mob violence. Thomas Pim Cope, his grandfather, founded the house of Cope Brothers, famous in the early mercantile annals of Philadelphia. His father was Alfred, the junior member of the firm, a man of very active intellect, who showed rare judgment in Edward's education. Together the father and son became brisk investigators, the father stimulating by questions and by travel the strong love of nature and of natural objects which the son showed at an unusually early age.

In August, 1847, they took a sea voyage to Boston, and the son's journal is full of drawings of jellyfish, grampuses and other natural objects seen by the way. When eight and a half years old he made his first visit to the Museum of the Academy of Natural Sciences, 'on the 21st day of the 10th Mo., 1848,' as entered in his journal; he brought away careful drawings, measurements and descriptions of several larger birds, but especially the figure of the entire skeleton of an Icthyosaur, with this quaint memorandum: "Two of the sclerotic plates look at the eye—thee will see these in it." At the age of ten he was taken upon a longer voyage to the West Indies. Thus the child was in a remarkable degree the father of the man. The principal impression he gave in boyhood was of incessant activity in mind and body, of quick and ingenious thought, reaching in every direction for knowledge, and of great independence in character and action. It is evident that he owed far more to paternal guidance in the direct study of nature and to his own impulses as a young investigator than to the five or six years of formal education which he received at school. He was especially fond of map drawing and of geographical studies. His natural talent for languages may have been cultivated in some degree by his tutor, Dr. Joseph Thomas, an excellent linguist, editor of a biographical dictionary. Many of his spare winter hours were passed at the Academy. After the age of thirteen the summer intervals of boarding school life and later of tutoring were filled among the woods, fields and streams of Chester county, Pa., where an intimate knowledge of birds was added to that of batrachians, reptiles and insects. He always showed a particular fondness for snakes. One of these excursions, taken at the age of nineteen, is described in a letter to his cousin (dated June 24, 1859); at the close of a charming description of the botany of the region appears his discovery of a new type:

"I traced the stream for a very considerable distance upon the rocky hillside, my admiration never ceasing, but I finally turned off into the woods towards some towering rocks. Here I actually got to searching for Salamanders and was rewarded by capturing two specimens of species which I never before saw alive. The first (*Spelerpes longicauda*) is a great rarity here. I am doubtful of its having been previously noted in Chester county. Its length is 6 inches, of which its tail forms nearly four. The color is deep brownish yellow, thickly spotted with black, which becomes confluent on the tail, thus forming bands. To me a very interesting animal—the type of the genus *Spelerpes*, and consequently of the subfamily Spelerpinæ, which I attempted to characterize in a paper published in the Proceedings of the Academy of Natural Sciences. I send thee a copy, with

* In the preparation of this article the writer is indebted to several members of Professor Cope's family, also to Professor Bashford Dean and to Professor George Baur. The latter has contributed especially a section upon the Reptilia.

the request that thee will neither mention nor show it,* for—however trifling—I would doubtless be miserably annoyed by some if thee should. Nobody in this country (or in Europe, of *ours*) knows anything about Salamanders, but Professor Baird and thy humble coz., that is in some respects. Rusconi, the only man who has observed their method of reproduction, has written enough to excite greatly one's curiosity and not fully satisfy it. With suitable appliances of aquariums, etc., I should like to make some observations. The other Salamander I caught was *Plethodon glutinosum*—the young—remarkable for the great number of teeth that lie together in two patches on the 'basisphenoid' bone; about 300 or more."

Another passage gives an insight into his strong opinion, so often expressed afterward, as to what constitutes the real pleasures of life:

"Pleasant it is, too, to find one whose admiration of nature and detail is heightened, not chilled, by the necessary 'investigation'—which in my humble opinion is one of the most useful as well as pleasing exercises of the intellect, in the circle of human study. How many are there who are delighted with a 'fine view,' but who seldom care to think of the mighty and mysterious agency that reared the hills, of the wonderful structure and growth of the forests that crown them, or of the complicated mechanism of the myriads of higher organisms that abound everywhere; who would see but little interesting in a fungus, and who would shrink with affected horror from a defenseless toad* * * Dr. Leidy is getting up a great work on comparative anatomy which is to be the modern standard. Such a work will be very useful to those who want to go to the bottom of natural history; it is an interesting study, too, to notice the modifications in form—the degradations,† substitutions, etc., among the internal organs and bones. The structure, forms and positions of teeth, too, are interesting to notice—so invariably are they the index of the economy and the position in nature of the animal."

This is the reflection of a lad of nineteen, an age at which some modern educators would have us believe our young men are just ready for the collegiate Freshman class.

*This passage probably indicates that he was sensitive to being teased about his interest in these animals.

†A word used by French writers of the time to express lines of descent.

During the same year young Cope went to Washington to study and work in the Smithsonian Institution under Spencer F. Baird, and it is amusing to observe him in the above letter classing himself with Baird as the only Americans who knew anything of the Batrachia. Upon April 19, 1859, he contributed his first paper (alluded to above) to the Academy 'on the primary divisions of the Salamandridæ, with a description of two new species.' He followed this by a full description in the same year of reptiles brought from West Africa by Du Chaillu, naming several new forms; also by a catalogue of the venomous snakes in the museum. In the succeeding three years he made twenty-four communications upon the Reptilia and established himself at the age of twenty-two as one of the leading herpetologists of the country.

It is obvious from other portions of the letter that by this time young Cope's career was fully determined in his own mind. Here and in the papers he was now presenting he shows keen observation and powers of systematic diagnosis, a wide range of self-acquired knowledge, and familiarity with the characteristics of his distinguished seniors, Agassiz and Leidy. This period included a year's study (1858–9) of anatomy and clinical instruction at the University of Pennsylvania. In 1863 he traveled abroad for several months, visiting especially the museums of Leyden, Vienna and Berlin and extending his horizon as a comparative anatomist, for upon his return he at once showed the impulse of the philosophical spirit, complete familiarity with the history of opinion and marked power of generalization. Thus his papers, which began to crowd the pages of the 'Proceedings of the Academy,' chiefly in recent herpetology and ichthyology, display a new breadth and range as in his division of the Anura into the *Arcifera* and *Raniformes* (Firmisternia) and his demonstra-

tion of the main evolution principles in these groups.

In 1865 he married Miss Annie Pim, daughter of Richard Pim, of Chester Co., Pa. In the year 1864 Haverford College called him to a professorship of natural science. This position, however, he held for only three years. Twenty-two years later he again resumed teaching as professor of geology and paleontology in the University of Pennsylvania, all the interval having been devoted to exploration and research. In 1865 he first began to extend his studies among the mammalia, especially the Cetacea, recent and extinct, of the Coastal Tertiary. Early in 1866 a wider paleontological field opened in the vertebrata of the Cretaceous marls of New Jersey, whence he procured the remains of Dinosaurs, describing especially the carnivorous *Lælaps*, and grouping (Nov., 1866), these reptiles into three great suborders, *Orthopoda* (Hadrosaurus and Iguanodon), *Goniopoda* and *Symphopoda* (Megalosaurus, Lælaps and Compsognathus). In the same year appeared the continuation of his tropical American and Sonoran herpetology and his third contribution to the history of the Cetacea. Henceforward his papers become far too numerous to consider together and we must endeavor to follow merely the main outlines of his life work.

This was a bright era in the history of the Academy, Leidy, Gill and Harrison Allen being frequent contributors. In 1868 Cope gave his first complete synopsis of the extinct Amphibia of the world. Between 1868 and 1870 he made his first six contributions upon the Plesiosaurs of the Cretaceous of Kansas and in 1871 began his first western explorations in these beds. This led to his connection with the U. S. Geological Survey, under Dr. Hayden, and to further explorations in Wyoming (1872) and Colorado (1873), which resulted in the discovery of many new types of fishes, mosasaurs, chelonians, dinosaurs and other reptiles, notably *Portheus*, *Platecarpus*, *Clidastes*, *Compsemys* (type of the Amphichelydia, Lydekker), *Protostega*, and *Agathaumus*. These were described chiefly in the Bulletins of the Survey and in the Transactions of the American Philosophical Society, and culminated in his first large volume The Vertebrata of the Cretaceous Formations of the West,' No. II., of the Hayden quartos, published in 1875.

He spent his summers in the Bad Lands, exploring the Bridger and Washakie, Wasatch, New Mexican and Judith River (1877 formations). The latter exposures he visited in 1874, in connection with the Wheeler Survey, securing a collection which is now preserved in the National Museum, and publishing a most vivid description of the geology of this interesting region. His movements in the field are described by one who was with him as so rapid and full of energy, so regardless of food and rest, that he wore out the other members of his parties and did not allow time for thorough search; yet he himself found a number of his most important types.

The fruits of the New Mexican journey appeared in many bulletins and were finally collected in his second great volume, 'The Extinct Vertebrata obtained in New Mexico by Parties of the Expedition of 1874,' Vol. IV., of the Wheeler Survey. In 1874 appeared the first of his studies upon the comparison of American and European horizons, and of his contributions to the John Day fauna. His collections were now accumulating so rapidly as to demand more time for research and for many years he was fortunate in securing the field services of C. H. Sternberg and Dr. J. L. Wortman. He continued to make brief expeditions, among the last being his trip into the Laramie region.

As early as 1868 it may be said that he had laid the foundations for five great lines

of research, which he pursued concurrently to the end of his life; these must, however, be followed separately to be understood and appreciated. Only for comparatively brief intervals would one line be pursued exclusively in order to complete some special memoir, for his marvelous memory apparently held and resumed the details of all the others with perfect ease.

FISHES.

Cope's work in ichthyology would alone have given him high rank among zoologists. In his early papers (1864) he appears as an enthusiastic systematist, studying especially the living forms of Teleosts, making careful diagnoses of all types that came into his hands, critically considering the problems of distribution, never casting aside those types whose especial difficulties had been the stumbling block of earlier writers. Thus he studied successively the fishes of Michigan (1864–65), of Virginia (1868), of the Lesser Antilles (1870), the cyprinids of Pennsylvania (1867), again the fishes of South Carolina (1871), of Alaska (1872), of Montana, those from South America collected by Professor Orton (1872–78), those from the territories collected by the Wheeler Survey, and even not infrequently new forms from Africa and the East Indies.

Almost from the first he set aside the superficial characters which had been employed in the classification of fishes, sympathizing keenly with the morphological spirit in systematic study which Dr. Gill was then showing. A great step in his career was, therefore, his purchase, while abroad, of Professor Hyrtl's private collection of fish skeletons, which gave him nearly a thousand admirable preparations for immediate study. Owen had proposed (1866) the Teleostomi to include the old Ganoids and Teleosts. Before the American Philosophical Society, in 1870, and the American Association, in 1871, Cope demonstrated the law that the primary divisions of the Teleostomi are indicated by their *fin structure*. This is now the accepted basis of sub-ordinal classification. Besides proposing the *Actinopteryii*, he established the fundamental division (Holocephali, Selachii, Dipnoi, Crossopterygii, Actinopterygii) of the living fishes into five groups, as they stand at the present day, upon cranial and fin structure. In 1876 Huxley adopted Cope's wide separation of the Holocephali from the Selachii. Fin structure as a taxonomic motive was uppermost in his mind and undoubtedly served to direct his attention later to the foot structure of land vertebrates as of diagnostic value.

The masterly part Cope continued to play in the major classification of the fishes may be gathered from a perusal of the introductions of Smith Woodward's standard volumes 'Catalogue of Fossil Fishes of the British Museum.' In 1884 he proposed a new Elasmobranch subclass, *Ichthyotomi*, from the Permian *Diplodus*. This order was subsequently enriched by his discovery of *Didymodus* and is now firmly established to include the pleuracanth and other paleozoic sharks. In 1889 he proposed another great sub-order, the *Ostracodermi*, which is also established.

His interest in the phylogeny of the group was naturally intensified by increasing knowledge of extinct forms, and here his wide studies among living types stood him in good stead, for he was first brought in contact with fishes from the Tertiary and Cretaceous, from the vertebrate remains from the New Jersey Greensand (1869) to the rich yields of the Green river shales (1871–7). The older fishes had long been in the hands of Professor Newberry, the pioneer among the fossil fishes of North America, but his studies came naturally to lead him among the more ancient types in his eager study of phylogeny. Into this difficult field he carried his work always with

suggestive results; for the most abstruse problems he had ever at hand a wide range of answers. Thus the curious fish-like *Bothriolepis* he compared to an armored ascidian, basing this surprising view upon a remarkable similarity in the arrangement of plates, arguing that it was reasonable to expect in the early horizon of *Bothriolepis* that the back-boned creature should be built on the plan of the ascidian tadpole. His final opinions and additions to the taxonomy and phyogeny of the fishes are inserted in the syllabus of his university lectures (1897).

AMPHIBIANS.

"There never has been a naturalist," writes Dr. Baur, "who has published so many papers upon the taxonomy, morphology and paleontology of the Amphibia and Reptilia as Professor Cope." The first of a series of more than forty papers upon the former group is the one 'On the Primary Divisions of the Salamandridæ, with descriptions of two new species,' alluded to in his letter above, and presented at the age of 19 (April, 1859). It exhibited the precocious taxonomic instinct which soon afterwards prompted him to attack and rearrange the major divisions of the Amphibia. Rapidly following this first essay by others upon the Anura, in 1865 and 1866 he outlined the larger Ecaudate or Anurous divisions: I. Aglossa; II. Bufoniformia; III. Arcifera; IV. Raniformia. At the age of 25 he described his first extinct Amphibian, *Amphibamus*, from the Carboniferous of Ohio, and at 28 he published his first large quarto memoir, 'Synopsis of the Extinct Batrachia, Reptilia and Aves of North America.'* This contained, in addition to the above, the recent urodelous divisions, Trachystomata, Gymnophidia, Proteida, but of chief importance, to include the Permian and Triassic forms of the world, he proposed the great extinct order *Stegocephali*, which has since been universally adopted. As a supplement to this memoir appeared in 1874 his 'Catalogue of the Air-Breathing Vertebrata from the Coal Measures of Ohio,' including results also published in the paleontology of the Geological Survey of Ohio of the same year. His researches and collections in the typical coal measures and Permian extended to Iowa and Illinois, leading to the determination of *Cricotus*, which in 1880* he made the type of the suborder *Embolomeri*, or Stegocephalia with double vertebral rings. In 1877 he received the first remains of *Eryops* and *Trimerorachis*, from the supposed Triassic, but actually Permian beds of Texas, animals which in 1882 he made the type of the *Rachitomi*, a second suborder of Stegocephalia. This accession of material, as we have seen, ranks with that of the Puerco among the chief events of Cope's scientific career, for the Permian of Texas yielded to him not only these remarkable Batrachians with complex vertebræ, but also the great primitive representatives of the Reptilia. The suborders Rachitomi and Embolomeri have been grouped as Temnospondyli in contrast with the specialized Labyrinthodontia and simpler Microsauria of Europe, chiefly made known through the labors of Fritsch, Credner, Gaudry and Miall. Cope's brief memoir of 1884 upon the 'Batrachia of the Permian Period of North America' summed up his previous contributions, but he anticipated that the more exhaustive monographic treatment of the rich amphibian and reptilian fauna of this period, exclusively collected and described by him, would constitute a volume of the Hayden Survey memoirs and give him an opportunity of rounding up his prolonged studies.

In the meantime his investigations upon the living Batrachia extended to Central and South American species, as well as to very original observations upon the laws of

* Trans. Amer. Phil. Soc., read 1868, pub. 1869. See also Proc. Phil. Acad. Nat. Sci., 1868, p. 211.

* *American Naturalist*, p. 610.

geographical distribution of the Amphibia, which were published by the Smithsonian Institution. In 1875 he prepared a 'Check List of the North American Batrachia and Reptilia' for the U. S. National Museum; this was followed by an essay 'On the Zoological Position of Texas' (1880). Soon afterwards, at the request of Spencer F. Baird, he began the preparation of a general work upon the Batrachia; this was facilitated by a manuscript prepared for a work of the same character both by Baird and Girard, but was not completed until 1889. As a volume of 523 pages and numerous plates this work,* while showing many signs of haste and subject to considerable changes in the larger systematic divisions, fortunately remains as a monument of the immense range of knowledge and observation of its author upon the structure and habits of the living representatives of this group. It must always be a matter of regret that he could not have published his final views upon the extinct forms. One of his most most important generalizations from the latter, contained in a short memoir, 'The Intercentrum of the Terrestrial Vertebrata' (1881), is that the vertebræ of living amphibia are composed of intercentra and are, therefore, not homologous with the true centra (pleurocentra) of reptiles, birds and mammals.

REPTILES.

We have already traced Cope's initial work upon the Reptilia. As in other groups, his researches rapidly branched out in many directions, first his treatment of the reptiles of the Bridger and other freshwater Tertiary lakes in connection with the mammalain fauna; second, the continuation of his systematic description of the Kansas Cretaceous fauna; third, the brief papers upon the herbivorous Dinosaurs of the Dakota (1877 and 1878) and the horned Dinosaurs (*Monoclonius*) of the Laramic formations; fourth, the numerous papers upon the Reptilia of the Triassic and especially of the Permian. The latter must be considered the most important and unique in their influence upon paleontology. In 1875 he first announced the discovery of reptiles in the Permian, and in 1877 he reported the first primitive Crocodilia (*Belodon*) and Dinosauria (*Clepsysaurus* and *Zatomus* in the Triassic of North Carolina.

The detailed sequence of this reptilian work is clearly stated by Professor Baur: "Already in 1864 he published a paper on the characters of the higher groups of the Squamata.* Two years later he made his first remarks about the Dinosaur *Lælaps*,† and in 1867 he compared the carnivorous Dinosaurs with the birds; ‡ this he did before Huxley's paper upon the same subject appeared. §

In 1870 he read an important paper before the American Association 'On the homologies of some of the Cranial Bones of the Reptilia and the systematic arrangement of the class.' || He discussed the following topics.: 1. Homologies and Composition of the cranial arches. 2. The cranium of the Ichthyosauria. 3. The cranium of the Anomodontia. 4. The homologies of the opisthotic. 5. The squamosal bone. 6. The columella (epipterygoid.) 7. The systematic arrangement of the Reptilia. 8. Critical remarks on the system. 9. The Rhyncocephalia and supposed Lacertilia of the Trias and Permian. 10. Stratigraphic relation of the orders of Reptilia.

His classification is this:

A. Extremities beyond proximal segment not differentiated as to form.

I. *Ichthyopterygia:* Order *Ichthyopterygia.*

* 'The Batrachia of North America.' Bull. No. 34, U. S. Nat. Museum.

* Proc. Acad. Phila., 1864, p. 224.

† *Lælaps aquilunguis*, Cope. Proc. Acad. Nat. Sci., Phila., July, 1866, p. 275-279.

‡ Ibid., 1867, p. 234-235.

§ *Popular Science Review*, 1868, p. 237-247.

|| Proc. Assoc. Adv. Sci., XIX., p. 194-247.

B. Extremities differentiated.

II. *Streptostylica*: Orders *Lacertilia, Pythonomorpha, Ophidia.*

III. *Synaptosauria:* Orders *Rhyncocephalia, Testudinata, Sauropterygia.*

IV. *Archosauria:* Orders *Anomodontia, Dinosauria, Crocodilia, Ornithosauria.*

In 1875 the large volume 'The Vertebrata of the Cretaceous Formations of the West' appeared, as Vol. II., of the Rep. U. S. Geol. Surv. Territ. (302 pp., Pl. LVII.). This work contains extensive descriptions, especially of the Mosasaurs, also of Testudines, Crocodilia, Plesiosaurs and Dinosaurs (Iguanodontia): *Agathaumus*, Cope (*Triceratops*, Marsh(; *Hadrosaurus*, Leidy (*Trachodon*, Leidy; *Diclonius*, Cope, *Claosaurus*, Marsh).

Cope's most epoch-making contributions, however, are his researches on the Permian Reptiles of Texas, which commenced in 1878. In the Proceedings of the American Philosophical Society of this year he established the sub-order *Pelycosauria* of the *Rhynchocephalia* to contain *Clepsydrops, Dimetrodon, Diadectes, Bolosaurus, Pariotichus, Empedias.* In the December *Naturalist* of the same year the order *Theromorpha* was created, with the sub-orders *Anomodontia*, Owen, and *Pelycosauria*, Cope. The *Pelycosauria* were considered as the ancestors of the *Mammalia.* In 1880* a new division of the Theromorpha was established, with the name of *Cotylosauria*, to contain the family *Diadectidæ.* In a skull of *Empedias* he described two occipital condyles, being misled by the missing basioccipital. In 1883† he placed his genera *Pariotichus* and *Pantylus* in a new family *Pariotichidæ*; characterized by the over-roofing of the temporal fossæ and the presence of the supra-occipital and par-occipital plates (intercalare, Cope). He now found the basi-occipital in position and the *Cotylosauria* were given up. In 1890 (March 12th) Cope placed again the *Cotylosauria* as a sub-order with the Theromora distinguishing three families: Pareiasauridæ, Pariotichidæ, Diadectidæ. In 1882* Seeley had established the order *Pareiasauria*; Lydekker (1889) and Zittel considering it a sub-order of the Theromora. In 1892† the Cotylosauria were made an order by Cope. The two last papers published by Cope in the Proceedings of the American Philosophical Society give much new evidence about this very interesting group. The titles of these papers are: 'The Reptilian Order Cotylosauria'‡ and 'Second Contribution to the History of the Cotylosauria.'§ In this paper a new family, *Otocælidæ*, was described with the following characters: Posterior border of temporal roof excavated laterally by the meatus auditorius externus. Teeth present in a single row, not transversely expanded. Ribs immediately overlaid by parallel transverse derm-ossifications which form a carapace. This family he considered, or at least suggested was, ancestral to the Chelonians.

Cope had in preparation for many years an extensive work on the *Lacertilia* and *Ophidia* of the United States, to be published, like his *Batrachia*, in a bulletin of the United States National Museum.‖ The

* *American Naturalist*, p. 304.

† Proc. Amer. Philos. Soc., p. 631.

* Proc. Roy. Soc., Vol. 44, p. 383.

† Trans. Am. Phil. Soc., Vol. XVII.

‡ Proc. Am. Philos. Soc., Vol. XXXIV., 1896 (Feb. 2d), p. 436–457, Pl. VII.–IX.

§ Ibid., Vol. XXXV., p. 112–139, Pl. VII.–X. Aug. 15, 1896.

‖ Many preliminary papers have appeared for this publication, of which the following are named below:

'An Analytical Table of the Genera of Snakes.' Proc. Am. Philos. Soc., 1886, p. 479–499.

'The Osteology of the Lacertilia.' Proc. Am. Philos. Soc., Vol. XXX., 1892, p. 185–221. Pl. II.–VI.

'On Degenerate Types of Scapular and Pelvic Arches in the Lacertilia.' Journ. Morphol. Vol. VII., 1892, p. 233–244, Pl. XIII.

'The Classification of the Ophidia.' Trans. Amer. Philos. Soc., Vol. XVIII., April 15, 1895, p. 186–219, Pl. XIV.–XXXIII.

'On the Hemipenes of the Sauria.' Proc. Acad. Nat. Sci. Phila., August, 1896, p. 461–467.

MSS. for this work cost him much labor, especially during the past two years, and for a while interrupted all his other work. It was characteristic of him to turn aside for a laborious detailed investigation of the soft anatomy of the snakes in the hopes of finding some satisfactory means of classifying this puzzling group. This investigation constituted his latest original work and was barely completed before his death.

MAMMALIA.

Up to 1868 Leidy held the Western paleontological field exclusively. In this year Marsh and Cope also entered the Western territory and began the simultaneous exploration and description of a limited fauna in a somewhat limited region, with the inevitable result of a struggle for priority and a permanent rupture of friendly intercourse. It is necessary to allude to the fact, because it greatly affected the subsequent history of American paleontology. Fortunately, the western fossil area proved to be a vast one, and the remarkable discoveries by Wortman in the Big Horn and Wasatch, beginning in 1878, also by Baldwin in the Puerco of New Mexico, beginning in 1880, and the explorations already described of Cummins in the Permian of Texas, afforded Cope a noble field of research quite free from the haste of rivalry. From the Wasatch ungulates Cope established the stem forms of three lines of Perissodactyla and of far wider import than these, the foundations of the classification of the great group of Ungulata. The generalized *Phenacodus*, which he at first regarded as a perissodactyl, furnished the key to the evolution of the carpus and tarsus, from the serial (Taxeopod) to the displaced (Amblypod and Diplarthrous) types with the interlocking joints. Kowalevsky, in 1873, had pointed out the significant articulations of the metapodials; Cope now showed the still greater importance of the mutual articulations of the podials, firmly establishing thereupon the orders *Condylarthra* and *Amblypoda*, uniting Owen's Perissodactyla and Artiodactyla into the *Diplarthra*, and by hypothetical phyla connecting the Proboscidia and Hyracoidea with a still-to-be-discovered plantigrade, unguiculate, bunodont stem, the 'protungulate' of Huxley and Kowalevsky. These generalizations, despite errors of excess and of detail which Rütimeyer and Osborn have pointed out, constituted the first distinct advance in mammalian classification since Owen demolished Cuvier's 'pachydermata;' they rank with Huxley's best work among similar problems, and afford a basis for the phylogenetic arrangement of the hoofed orders which has been adopted by all American and foreign paleontologists.

At the same time it became apparent that the hoofed mammals had sprung from clawed ancestors, but the Wasatch period was too remote from the parting to furnish conclusive evidence. This evidence came in a flood from the underlying Puerco fauna, the systematic treatment of which constitutes the most unique section of Cope's work among the extinct mammalia. From this material originated his second great generalization—namely, that the primitive pattern of the molar tooth consists of three tubercles. Around this *trituberculy* centers the whole modern morphology of the teeth of the mammalia and the establishment of a series of homologies in the teeth of most diverse types, wholly unsuspected in the 'Odontologies' of Cuvier and Owen, connecting the most ancient Mesozoic mammals with the most modern and specialized types, including the teeth of man. The force and application of the tritubercular law Cope clearly perceived, but left to others to fully work out and demonstrate. It promises ultimately to give us the key to the entire phylogeny of the mammalia, extending to every division of the Marsupialia

and Placentalia, and will probably be found among the Monotremata.

These are the mountain peaks, the points where exploration and discovery were followed by happy inspiration, in a chain of contributions, which includes his exposition of the faunal succession from the base to the summit of the tertiary. In the Bridger, Cope himself found the lower jaw of *Anatomorphus*, with its typically human dentition, which, owing to its extreme antiquity, occasioned him a greater surprise than any discovery he ever made; he also found the last of the great race of Uintatheres at the top of Washakie Mountain. We owe to him alone our knowledge of the scanty Wind River fauna. From the White River Oligocene his materials were poor and his work less satisfactory. From the rich Upper Oligocene, with the assistance of Wortman, he secured fine collections and has especially enriched our knowledge of the *Anchitheriidæ*, *Felidæ* and *Canidæ*. From the Upper Miocene Deep River and Loup Fork beds he has practically contributed all that we know, especially of the Rhinoceroses, Horses, Mastodons, Camels and other ruminants and carnivora. Of the latter fauna his most complete papers were upon the evolution of the *Oreodontidæ*. His latest contributions to our knowledge of the fossil mammalia were upon the fauna of the Blanco and Palo-Duro, or Goodnight beds of Texas and the rich cave fauna from Port Kennedy, Pa., brought together by Dr. H. C. Mercer. It was his intention to cover the entire later Tertiary in a second part of the 'Tertiary Vertebrata;' many of the plates and much of the MSS. of this volume are ready.

The 'Tertiary Vertebrata,' Vol. III., of the Hayden quartos published in 1883, is his most imposing contribution to paleontology, including his studies of all the vertebrate fauna of the Tertiary lakes west of the Rockies. This work of over a thousand pages and eighty plates is said to have been the despair of the public printer owing to the constant additions made while in press. It extends from the Puerco to a portion of the Lower Miocene fauna. Besides the full description and illustration of the great hoofed orders above alluded to, it contains the full exposition of the characteristic forms of *Creodonta*, an order of primitive carnivora which he separated from the Marsupiala in 1875, and in which he placed six families of mammals from different parts of the world.

Before leaving the mammals it is fitting to speak of his work upon 'kinetogensis,' or the mechanical origin of the hard parts of the body, especially of the teeth, vertebræ and limbs. An invaluable paper by his friend and later colleague, Ryder, put him upon this line of investigation, the results of which he published in a long series of papers culminating in his memoir upon the 'Origin of the Hard Parts of the Mammalia' and in his collections of essays in the 'Origin of the Fittest' and 'Primary Factors of Organic Evolution.' One of his chief motives in these researches was the demonstration, he believed they afforded, of the hereditary transmission of the effects of individual efforts, use and disuse, but even if this motive is subsequently shown to be an illusive one, by our future knowledge of the real nature of evolution, these investigations lose little, if any, of their intrinsic value. First, as in all his work, he brings together an immense array of valuable facts and observations; second, he extends the principle of the independent origin of similar structures; third, he in most cases successfully establishes the actual mechanical adaptive or teleological relations of the parts described; fourth, he traces the course of phylogenic modification in a number of important organs and thus establishes certain obscure homologies, notably

those in the teeth of the Amblypoda, Coryphodon and Uintatherium.

PHILOSOPHY.

Cope's contributions to philosophy began in 1868, with the remarkable essay upon the "Origin of Genera,' and, continuing steadily in a series of papers which in collected form fill three octavo volumes, they cover both the data and the factors of evolution, psychology, ethics and metaphysics. Unpublished manuscripts, prepared in connection with his last work, 'The Primary Factors of Organic Evolution,' contain also his views upon many sociological and theological problems. It is singular that at the age of 28 he adopted the Lamarckian theory under cover of a misconception of a part of Darwin's theory, for he states the *latter* in part as follows: "This is, in brief, that the will of the animal, applied to its body, in the search for the means of subsistence and protection from injuries, gradually produces those features which are evidently adaptive in their nature." He soon detected this error; but a year later, in a paper upon 'The Laws of Organic Development,' before the American Association, he again connected rudimentary will or consciousness with use and effort, and struck the keynote of all his later evolution philosophy in the sentence: "Thus intelligent choice may be regarded as the originator of the fittest, while natural selection is the tribunal to which all the results of accelerated growth are submitted." (1869.)

His chief contention in the 'Origin of Genera' is that, while a large proportion of specific characters are adaptive, few generic characters are so, and the latter evolve separately by the force of 'acceleration or retardation' of one of several plans or types of development preordained by the Creator. To sustain this proposition he applied the principles of arrested, hastened or abbreviated development with extraordinary knowledge both of the osteology and soft anatomy of the entire vertebrata to hundreds of examples of *exact* and *inexact parallelism*,* and with such force that he completely establishes his law. Incidentally the principle of *heterology*, or what Lankester has since termed homoplasy, is abundantly illustrated. Darwin, in one of his letters, states that he never could understand this Cope-Hyatt† law of 'acceleration and retardation.' It is undeniable that its exposition might have been clearer; of its truth, not as a theoretical factor, but as a grand principle of evolution, there can, however, be no question, and it has received far less attention than it deserves.

Cope subsequently altered some of the main standpoints of this thesis, but his systematic definition of genera and families, horizontally or transversely to phyletic descent according to the heterologous assumption of similar structures, persisted as a conspicuous and confusing feature of all his later phylogenetic tables and writings. It is throughout evident that in 1868 he was still *en route* to his later broader conception of the sweeping extent and natural causation of evolution. He entered vigorously into the evolution compaign,‡ always showing great consideration and courtesy for his orthodox opponents and desiring rather to convert than to offend. As above noted, in 1870, he drew a sharp distinction between the 'preservation of the fittest' and 'the causes of the origin of the fittest,' which he ascribed to the increase and location of 'growth force.' In 1871 appeared 'The Method of Creation of Organic

* Parallelism is here used in the sense of recapitulation (von Baer), not of homoplasy or convergence.

† Professor Hyatt, Cope's fellow laborer in Lamarckism, worked out this law independently at the same time.

‡ 'On the Hypothesis of Evolution,' *Lippincott's Magazine*, 1870; 'Evolution and its Consequences,' *The Penn Monthly*, 1872.

Forms,'* in which he set forth in a most interesting way a complete system of the modes and causes of evolution under the five laws of: (1) Acceleration and Retardation; (2) Repetitive Addition; (3) Use and Effort; (4) Bathism or Growth Force; (5) Intelligent Selection. This system was largely original with him, because he had not as yet studied Lamarck's writings, knowing them only through abstracts; it cannot be said, however, that he ever either advanced beyond or substantially modified the theoretical position he reached at the age of 31. Later, as he carefully studied the writings of the great French naturalist, he fully recognized Lamarck's priority and accepted the Neo-Lamarckian title when it was applied to him during the Weismann controversy. Cope, Hyatt, Ryder and Packard became the pioneers of the school in America. It is not necessary here to detail his widely known arguments as champion of this philosophy, which he gathered from his rich stores of comparative anatomy and paleontology and put forth in numerous essays and public discussions, concluding with his final argument before the recent meeting of the American Society of Naturalists, in Boston.† Suffice it to say that he showed much of the same kind of confident strength and of the same logical weakness which characterized Lamarck. The latter, in fact, among all naturalist philosophers is Cope's nearest prototype. The papers upon the 'Origin of Intelligence' (1872), 'Consciousness in Evolution' (1874), 'The Origin of the Will' (1877), 'On Archæsthetism' (1882), follow a line of thought largely foreshadowed by Lamarck, but none the less striking. Cope was nothing daunted by Weismann's challenge and vigorous attack upon the transmission theory, and maintained to the end that the paleontological evidence was too strong to be refuted. His first collected essays, 'The Origin of the Fittest,'* antedated this discussion, but his second collection, 'The Primary Factors of Organic Evolution,'† enters into it very fully and with as much force of reason as the facts afford at present. This volume goes over some familiar territory, yet is striking because of the very wide range of fresh reading and research it gives evidence of. The concluding chapter contains (p. 508) his final statement of what may be called his fundamental causal principle—namely, the formative or creative rôle of consciousness from the dawn of life.

Side by side with these studies of the factors of evolution are numerous essays upon the history of man,‡ beginning in 1875, and upon the evolution of the vertebrata, progressive and retrogressive, which are full of speculative phylogeny. In formulating descent trees Cope has been second only to Haeckel. He let no opportunity slip by of at least throwing out an hypothesis as to the phyletic relations of every great type he studied, and many of these random guesses have been confirmed.

More remote from the main trend of his profession were his collateral intellectual pursuits, each of which seemed to issue from a clearly defined alcove of his brain upon consecutive occasions and express his ever widening and deepening philosophy. His progressive thought upon metaphysical problems can be followed in 'The Origin of the Will' (1877), 'Theology of Evolution' (1877), 'The Relation of Mind to Matter' (1877), 'Ethical Evolution' (1889),' An Outline of the Philosophy of Evolution' (1889), 'The Evolution of Mind' (1890), 'The Foundations of Theism' (1893).

*American Philosophical Society, December 15, 1871.

† Reported in SCIENCE, April 23, 1897.

* D. Appleton & Co., 1897, 8vo., 467 pp.

† Open Court Publishing Co., 1896, 547 pp.

‡ Among others see 'The Genealogy of Man,' *American Naturalist*, 1893; 'Lenurine Reversion in Human Dentition,' *Journal of Morphology*.

In this review no mention has been made of Cope's several papers upon fossil birds or of his extremely valuable contributions to historical geology.

We have at present few data for the history of his later life apart from that furnished by his writings. His editorial connection with the *American Naturalist*, begun in 1878, in association with Professor A. S. Packard, who retired a few years later, was continued for twenty years, with a great sacrifice of time. It afforded an outlet for his continuous stream of shorter publications and for the free expression of his very independent opinions upon current scientific movements and topics. This constant occupation kept him from foreign travel; at the time of the first Paris Exposition he made his second and final journey abroad. He was a close student but never a recluse. Extremely fond of the society of thinking people, he was also a very regular attendant upon the learned societies of his city and country. It is a cause for regret, and an instance of the non-recognition of genius, that only at a very late day the Society of Naturalists and the American Association for the Advancement of Science elected him to their chief offices. His retiring presidential address was to have been made at the coming meeting of the Association.

The most conspicuous feature of Cope's personal character from boyhood upwards was his independence; this was partly the secret of his venturesome and successful assaults upon all traditional but defective systems of classification. He was no respector of authority *per se*. Even if sometimes mistaken his fearless criticism of men and of institutions was chiefly animated by high ideals, not by personal feeling, nor for personal advantage. His open and aggressive statements made him many opponents and attracted to him many friends, because whether right or wrong they always sprang from conviction. Another marked characteristic was his fortitude. He bore material reverses with stoical resignation, regretting chiefly the limitations they placed upon his explorations. He was full of cheer and determination when things looked most unpromising, allowing nothing to disturb the composure which is so essential to research. His life in fact became a fine illustration of the happiness attendant upon plain living and high investigation which he foresaw at nineteen in his letter to his cousin quoted above.

Cope is not to be thought of merely as a specialist in paleontology. After Huxley he was the last representative of the old broad-gauge school of anatomists and he is only to be compared with members of that school. His life-work bears the marks of great genius, of solid and accurate observation and at times of inaccuracy due to bad logic or haste and overpressure of work. The greater number of his Natural Orders and Natural Laws will remain as permanent landmarks in our science. As a comparative anatomist he ranks both in the range and effectiveness of his knowledge and his ideas with Cuvier and Owen. When we consider the short life of some of the favorite generalizations of these great men he may well prove to be their superior as a philosophical anatomist. His work, while inferior in style of presentation, has another quality which distinguished that of Huxley—namely, its clear and immediate perception of the most essential or distinctive feature in a group of animals. As a natural philosopher, while far less logical than Huxley. he was more creative and constructive, his metaphysics ending in theism rather than agnosticism. In mere mass of production Cope's work was extraordinary. He leaves twenty octavo and three great quarto volumes of collected researches. By his untimely death a wide gap is left which can never be filled by one man.

HENRY F. OSBORN.

COLUMBIA UNIVERSITY, May 3, 1897.

*PSYCHOLOGY AND COMPARATIVE PSYCHOLOGY.**

It is now more than ten years since I suggested to a few of the students of this Faculty of Comparative Medicine that it might be interesting and profitable to band together for the study of the psychic nature of animals, particularly those animals with which we are brought into daily contact.

In December, 1885, at a meeting called to consider the subject, it was unanimously decided that a society should be formed to study animal intelligence as best it could. Practically all the students and those teachers more immediately connected with the work of this Faculty joined the Association and entered into the new project with enthusiasm. It was early decided that only material obtained either at first hand or from the most reliable sources should be brought before the Association, and that principle, the wisdom of which will not be questioned, has been acted upon throughout.

Whatever the value of the papers and discussions which have engaged our attention it may be fairly claimed that the facts upon which they have been based were beyond question. The first essential in any student of nature is a strong desire to know the truth, and, therefore, a great respect for exact observation at the outset. While theories change, and this is inevitable owing to the imperfection of our grasp of many-sided truth, a fact is always a fact. The patient collection of facts, so well illustrated by the illustrious Darwin, when theorizing without very great regard to them was so tempting in framing explanations of organic nature, is a work that the world long undervalued and the importance of which it is to be feared all psychologists at the present day do not adequately appreciate.

*An address delivered to the Association for the study of Comparative Psychology in Montreal, November 2, 1896.

In this, at all events, our unpretentious Association may claim to have trodden in the safe path. At the end of our first decade of existence it may be profitable to review what has been accomplished. It could scarcely be expected that the members of this Association, being for the most part undergraduates, whose time is largely taken up with professional studies, should be able to make elaborate original researches worthy of publication. From the first, however, our proceedings have been given to the public in condensed form by the local press, and evidence has been abundant on every hand that one of the results has been an altered attitude of mind on the part of many intelligent persons in this city towards the animal world about us, notably our domestic species. This is not a work to be despised, for the welfare of our fellow creatures lower in the scale is largely dependent on the views we entertain of their psychic nature.

It is surely not to be supposed that such studies as have engaged the members of our Association are without a value of a professional kind; for in the handling of sick animals, in diagnosing their exact condition, in appreciating their sensations and generally in understanding their entire nature, the man who observes and reflects on such things must be more competent as a veterinarian, other things being equal, and certainly a more agreeable visitor to both patients and clients.

But it is difficult, in my opinion, to overestimate the good to the individual who in the right spirit studies animals. A frame of mind is established which, even when one exaggerates animal intelligence, is rarely practically harmful—often the reverse—and nearly always begets sympathy and modesty.

Psychology has passed through great changes, during even the last decade. Now almost every college in America of much

importance has its chair of psychology, and many colleges are provided with psychophysical laboratories. In America alone there are two periodicals devoted to this subject; and at last pedagogical institutions are attempting to found the training for teachers on the laws of the mind, *i. e.*, on psychology. In fact no recent educational movement has been more widespread in its influence or more rapid in its development than the modern psychology.

The scope and methods of the science have also changed. While none the less introspective, it has become more objective. The allied science of physiology owes something to psychologists, notably in the direction of a more complete and accurate study of the senses and keen criticism of positions assumed by physiologists in regard to the central nervous system.

The psychologists have borrowed freely from the realm of mental and nervous disease; all of which marks a new departure from which not only psychology, but physiology and practical and scientific medicine, must benefit.

It is usually a hopeful sign when methods of exact estimation begin to be applied to any science. There has been much diversity of opinion as to the extent to which this can be or has been successfully done in psychology. In the opinion of one of the most accomplished workers in this department of the science who occupied the presidential chair at the last meeting of the American Psychological Association, there can be no doubt about the value of such methods and their application. He says: "I venture to maintain that the introduction of experiment and measurement into psychology has added, directly and indirectly new subject-matter and methods, has set a higher standard of accuracy and objectivity, has made some part of the subject an applied science with useful applications, and has enlarged the field and improved the methods of teaching psychology."

But what shall we say of the *status* and prospects of comparative psychology? The works of Romanes were well known prior to the beginning of the last decade. They may be considered as marking about the first serious attempts to treat the subject of comparative psychology in a truly scientific spirit and in a form accessible to the intelligent portion of the general public.

Much later appeared the books of Professor Lloyd Morgan—works which possess the charm of unusual clearness. If Romanes was open to the charge of claiming too much for animals, Morgan is certainly cautious enough to please the most conservative, unless it be those who deny true intelligence to animals entirely.

It is a hopeful sign of the times in psychology that a professor of philosophy, Dr. Carl Groos, of Giessen, has found material for a book of considerable size on the play of animals, a subject which has been treated by him with interest, learning and critical acumen.

Animal intelligence is more and more attracting the attention of the professed psychologist and biologist, and that both realize the difficulties of the subject, while its importance is acknowledged, is of good omen. Comparative psychology is now beyond the stage of neglect and contempt, though there are those who seem to think that before we can judge of the mental processes of animals much greater progress must first be made in the study of the human mind; in other words, they would take their standards, their criteria from human psychology. That we must in the end find the clue to interpretation from ourselves there is no doubt. But is it not the fact that every complicated subject has been advanced by studies on a lower plane and by the process of comparison? Anatomy and mammalian embryology would

scarcely be worthy of the name of sciences to-day but for studies conducted on simpler forms. Do not psychologists sometimes forget, as anatomists long did, that the human is scarcely to be comprehended apart from the study of simpler creatures? Should we not look at psychology as the naturalist now does at zoology, and endeavor to discover the various grades in psychic processes, if such there be, and it is only, so far as I can see, by comparative investigation that their existence or non-existence can be established.

To do such work at its best requires a knowledge of both biology and psychology, and an intimate acquaintance with the ways of animals. Closet lucubrations can not be expected of themselves to advance comparative psychology very much.

Might not human psychology be made more objective still, and is not the amount of wheat garnered much out of proportion to the quantity of sheaves brought to the thresher? Has individual psychology received the attention it deserves? Might not the inductive method be more fully applied to psychology? I have long been convinced that differences for races and for individuals have been insufficiently recognized in physiology, and at last there seems to be a reaction against the former reckless leaps from frog or rabbit to man.

The physiologist cannot, however, afford to ignore the frog or the rabbit even when his goal is man; nor, if I may venture to express an opinion, can the psychologist do so either without some loss,—possibly great loss, to his subject.

I hope to see published in the next few years detailed studies on many individual human beings of both sexes and also on individual animals. We must have more facts for our conclusions. The departures of French psychologists are very welcome, whatever the final outcome may be. It cannot be doubted that the study of hypnotism, double personality and morbid states of various kinds has greatly advanced our knowledge of the normal man, and his fellows lower in the scale; and I should be disposed to say that the investigation of the psychic processes of animals aids in the comprehension of even such abnormal states as those to which reference has been made.

At the recent great Psychological Congress at Munich there was, among others, a department for comparative psychology; and an endowed lectureship on this subject has recently been established at Aberdeen, so that it is clear that in this, as in other directions, the world is moving.

If my view is correct that we are in need of vastly more facts and observations, then is there room for many workers. The experimental has a wide range of application in comparative psychology and as yet but little has been done. In this direction, as I have urged for years on our members, we could do much to advance the subject we have at heart.

It has been my happy privilege to attend every meeting of this Association held since its foundation, and reviewing the work of the past ten years I feel that, although it has been a humble one, the Society for the Study of Comparative Psychology in Montreal has not existed in vain.

Wesley Mills.

McGill University.

PAREIASAURIA SEELEY (COTYLOSAURIA COPE) FROM THE TRIASSIC OF GERMANY.

The first notice on *Triassic Pareiasauria* was published in 1857 by Professor Fischer, of Freiburg in Breisgau, based on notes received from the eminent paleontologist Hermann von Meyer, to whom he had sent the specimen for examination. The title of the paper is: *Über Sclerosaurus armatus* H. v. Meyer, eine neue Saurier-Gattung aus dem Bunten Sandstein bei Warmbach gegenüber Rheinfelden. Hierzu Tafel III

nach einer Photographie [und eine Figur, Wirbel und Rippen]. Neues Jahrb, f. Mineral., Geogn. Geol. und Petrefactenkunde, Jahrgang, 1857; Stuttgart, 1857, p. 136–140. Two years later H. v. Meyer gave an excellent description with a very good plate of this specimen in the Palaeontographica Bd. VII., 1. June, 1859, p. 35–40, Taf. VI. "*Sclerosaurus armatus* aus dem bunten Sandstein von Rheinfelden." This most interesting form has been entirely overlooked in all modern text-books and hand-books of paleontology and by all authors who have written about the *Pareiasauria.**

The specimen was found in the upper layers of the 'Bunte Sandstein,' near Ingerfelden, in Baden, n. w. of Rheinfelden, in Switzerland, with *Gyrolepis alberti*, Agassiz. The fossil consists of twelve consecutive presacral vertebræ, the ribs in connection, the pubis, the two femora, and the dermal armour.

The vertebræ, the rib-articulations, the pubis are typically Pareiasaurian. Of the greatest interest is the dorsal armour. There is a median series of rhombic plates, somewhat broader than long, the posterior end a little overlaped by the anterior end of the following plate. Each of these plates corresponds to a single vertebra. With the posterior sides of the plates of the median row, 2 or 3 more or less rhomboidal plates are connected, which cover the ribs. Therefore for each segment there are one median and 2 or 3 lateral dermal plates. Their connection is loose.

In *Pareiasaurus* Owen we have also a dorsal armour. Three rows of scutes extend down the median line of the back, and are partially in contact with the neural spines. The median row is placed on the summits of the neural spines. In connection with these, laterally, there is a pair of scutes extending transversely outwards (Seeley). In 1878 Wiedersheim* published a paper entitled *Labyrinthodon Rütimeyeri.* Ein Beitrag zur Anatomie von Gesammtskelet und Gehirn der triassischen Labyrinthodonten. Abhandlungen der schweizerischen palaeontol. Gesellsch., Vol. V. 1878, p. 1–56, Pl. I.—III.

The specimen on which the description is based was discovered in 1864 at Riehen (Switzerland), near Lörrach (Baden). The locality in which *Sclerosaurus* was discovered is only 11 kilometers distant from the locality in which Wiedersheim's '*Labyrinthodon*' was found. In both places *Gyrolepis Alberti* Agassiz occurs, and there is no doubt that these forms came from exactly the same horizon of the Upper Bunte Sandstein.

The specimen of *Labyrinthodon* is nearly complete, but some of the bones have been destroyed, leaving only the vacuities. This fossil is no *Labyrinthodont* at all, but a *Pareiasaurian* identical with *Sclerosaurus armatus* H. v. Meyer.

Already *Zittel*† has doubted its Stegocephalian nature, and stated that it probably belongs to the reptiles, giving several reasons for this opinion. The latest contribution is from *Seeley. On the complete skeleton of an Anomodont Reptile (Aristodesmus Rütimeyeri, Wiedersheim) from the Bunter Sandstone of Riehen, near Basel, giving new evidence of the relation of the Anomodontia to the Monotremata.*‡ Seeley has examined the specimen

*I may mention here that the same is true for *Pristerodon McKayi*, Huxley from the Permo-triassic of South Africa. T. H. Huxley. On *Saurosternon Bainii* and *Pristerodon McKayi*, two new fossil Lacertilian Reptiles from South Africa. Geol. Magaz. Vol. V. No. 5, May, 1868, p. 1–4, pl. XI. and XII.

*This paper is absolutely useless, full of mistakes and unsound ideas, indicating absolute inability to handle the material.

† Zittel, Karl A. Handbuch d. Palaeont. Palaeozool. III. Band., 1888, p. 407-408.

‡ Ann. Mag. Nat. Hist. (6) Vol. 17. Febr., 1896, p. 183-184. (From Proc. of the Royal Society.)

and reaches the following result: The reputed humerus is the interclavicle; the reputed scapula is the humerus; the reputed supra-scapula is the left coracoid; the reputed supra-scapula is the right scapula; the reputed right and left coracoids are the pre-coracoid (epicoracoid) and coracoid of the right side; the reputed clavicles are ribs. Five digits are identified in place of four. The fossil is referred to a new genus —*Aristodesmus*. It is identified as an Anomodont reptile, chiefly on the basis of resemblence to *Procolophon* and *Pareiasaurus*. He also compares it with the *Monotremata*. In conclusion, he argues that the points of structure are so few in which *Monotreme* mammals make a closer approximation to the higher mammals than is seen in his fossil (*Aristodesmus*) and other *Anomodontia*, that the *Monotreme* resemblances to fossil reptiles become increased in importance. He believes that a group *Theropsida* might be made to include *Monotremata* and *Anomodontia*, the principal differences (other than those of the skull) being that *Monotremes* preserve the marsupial bones, the atlas vertebra and certain cranial sutures. *Aristodesmus*, which suggests this link, is at present placed in the *Procolophonia*, a group separated from its recent association with *Pareiasaurus*, and restored to its original independence because it has two occipital condyles [!], with the occipital plate vertical, and without lateral vacuities, and has the shoulder-girdle distinct from *Pareiasauria* in the separate precoracoid extending in advance of the scapula. In the same remarkable communication Seeley discusses, also, the relation of the Labyrinthodont type to the existing Amphibia, and *regards the Labyrinthodont osteology as demonstrating closer relationship with Ichthyosauria and Anomodontia. The group is therefore regarded as reptilian, forming a branchiate division of the class* [*!*]. What are such wild speculations good for?

To conclude I give the synonyms of this reptile.*

Sclerosaurus armatus, H. v. Meyer. Neues Jahrbuch f. Min., 1857, p. 136.

Labyrinthodon Rütimeyeri, Wiedersheim, Abhandl., Schweiz. Pal. Gesellsch. v. 1878, p. 1–56.

Aristodesmus Rütimeyeri (Wiedersheim); Seeley, Ann. Mag. Nat. Hist. (6), Vol. 17, 1896, p. 183.

G. Baur.

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CURRENT NOTES ON PHYSIOGRAPHY.

McGee on Sheetflood Erosion.

Sheetflood is a term coined by McGee (Bull. Geol. Soc. Amer., VIII., 1897, 87–112) to name the thin sheets of water that occasionally flow over the thinly gravel-covered intermont slopes of the Sonoran district in Arizona and bordering Mexico. It is contrasted with streams, in which a water current is gathered into a channel. Sheetfloods may be a mile or even ten miles wide, yet only a foot or two deep, running rapidly down slopes of one or two hundred feet to a mile; everywhere 'at grade;' that is, their ability to do work everywhere nicely balanced against the work that they have to do. By sheetfloods, not by streams, the peculiar gravel-covered rock floors of the Sonoran district are thought to have been planed down; and the abrupt transition from streams in the mountain gullies to sheetflood on the piedmont surface is taken to explain the equally abrupt transition from mountain to plain; the rocks remaining the same. Unlike the aggraded plains of the Utah, where intermont depressions are heavily filled with mountain waste, the

* *Basileosaurus Freyi* Wiedersheim (Über einen neuen Saurus aus der Trias. Mit einer Tafel. Abh. Schweiz. Pal. Ges., vi., 1879, 4 pp.) from Riehen is too insufficiently described and figured to determine its true position. It is doubtless a reptile, but, according to Wiedersheim, not *Sclerosaurus*.

rock plains of Sonora are only veneered with gravel and sand. At the outlet of mountain ravines McGee pictures and describes triangular, convex 'fans,' which are really carved in solid rock like the plains, and only veneered with alluvium. These must be retreating alluvial fans, in contrast to the advancing alluvial fans ordinarily seen in mountain valleys. After advancing for a time, fans of the latter class are often dissected by streams and thus worn away; but the Sonoran rock-fans seem to have been worn back by sheetflood action, thus preserving their form.

RELIEF MAP OF NEW JERSEY.

A HANDSOME and effective publication of the New Jersey Geological Survey is a new relief map of the State, on a scale of four miles to an inch. It is shaded in gray-brown, as if under northwest illumination, making the relief of the surface only too clear. The map will prove extremely serviceable, but it may be questioned whether a more delicate rendering would not have been more educative, particularly in the schools, where such a map as this must have its greatest and most important use. This is particularly the case in the southern part of the State, where the shading does not seem to be reduced to the delicacy of the faint inequalities in the surface, but where the inequalities of the surface are exaggerated to meet the demands of distinct shading and easy recognition. The effect produced by the southern plains does not tally with that gained on reading the text of the State Survey reports; it is as if the drawing of the relief map were done by a topographer accustomed to exaggerated sections on which an almost imperceptible natural slope becomes a distinct incline, rather than by a geographer who wished to give a just sense of the proportions of hills and plains. The criticisms directed against the vertical exaggeration of geographical models may be equally directed against so forcible a relief map as this. The map is headed with the names of John C. Smock, State Geologist, and C. C. Vermeule, topographer; but no explicit recognition is given to the artist who prepared the map or to the lithographer who printed it.

MORAINES OF THE MISSOURI COTEAU.

A REPORT with the above title by J. E. Todd forms Bulletin 144 of the U. S. Geological Survey. It is chiefly occupied with detailed descriptions of the moraines, from which one may gain a good idea of their importance in determining the relief of the Coteau. A map and many plates, apparently drawn in outline from photographs, afford good illustrations; but it is often difficult to identify localities between text and map. The Blue lake loop, 60 miles southeast of Bismarck, six to ten miles wide, is so rough, with so many stony hills and marshy hollows, as to present a formidable barrier to travel. One may easily lose his way on this undulating surface, where no conspicuous landmarks serve as guides. Many of the moraines are traversed by dry channels that once carried water from the melting ice sheet. The channels are now frequently occupied by small shallow lakes. The Ree hills, 40 miles east of Pierre, chiefly of Cretaceous beds with a veneer of drift, are traversed by an elaborate extinct drainage system; the main channel begins in a gap in the hills, receiving tributaries from either side on its way south, and gaining a depth of 60 to 70 feet with abrupt, stony sides, and a breadth of $\frac{3}{4}$ mile (p. 27).

NOTES.

THE two numbers of Appalachia for 1896 contain several good accounts of mountain ascents in the Canadian and Montana Rockies and in the High Sierra of California. A number of the plates are excellent; that of the Avalanche lake, Montana, being

particularly fine. Narrative, rather than physiography, characterizes the text; but much of the quality of our higher mountains can be gleaned from it. A sad interest attaches to the later pages, in the account of the death of Philip S. Abbot on Mt. Lefroy, Canada. The great precipices of the mountain are shown in a full-page plate.

The physiography of northern Indiana is described by C. R. Dryer (*Inland Educator*, IV., 1897, 63–69) as a contribution towards more rational geography in the schools. The region was first explained by Gilbert in 1870; the drainage is now shown to be even more dependent on morainic ridges than was at first supposed. North of the Maumee-Wabash line the moraines are heavier, enclosing numerous lakes and forming a most picturesque contrast to the flatter surface of the Erie clays around the lake border.

C. Sapper writes upon the physical geography and the geology of Yucatan (Bull. No. 3, Inst. geol. Mexico, 1896). A considerable area is described as of 'very strange topography;' lacking ridges of determinate direction, and everywhere gently undulating; the cause of this being ascribed to the horizontal position and the porous structure of the rocks, and to the 'sinks' consequently formed over subterranean channels. The same author describes the volcanoes of Salvador and southeast Guatemala (Petermann's Mitt., XLIII., 1897, 1–7). The volcano Guazapa is well dissected by radical valleys, while nearly all the others are young enough to have smooth contours.

John Murray, of the Challenger expedition, gives an account of 'Balfour shoal' (*Scot. Geogr. Mag.*, XIII., 1897, 120–134, two plates), probably a volcanic cone, rising from the Pacific bottom, east of Australia, in Lat. 19° S., Long. 157° E., from a depth of 1,300 fathoms to 836 fathoms. The side slopes are steepest on the northeast, where they reach 200 fathoms per mile, or 1 in 4.4. Examples of other oceanic cones may be found in a paper by G. W. Littlehales, entitled 'Average form of isolated submarine peaks,' published by our Hydrographic Office in 1890.

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CURRENT NOTES ON ANTHROPOLOGY.

THE MONOLITHS OF TAFI.

Tafi is the name of a broad valley in the province of Tucuman, Argentine Republic. The well-known scientist, Professor Ambrosetti, in a recent visit there, had his attention called to an extraordinary collocation of monolithic pillars and stone enclosures, erected in remote ages by the native inhabitants. He describes them in *Globus*, Bd. LXXI., No. 11. The monoliths are from six to ten feet in height above the soil, some plain, others decorated with conventional designs, others rudely chipped into the likeness of faces, etc. They extend over a considerable area and their purpose is problematical.

Ambrosetti is inclined to attribute them to the predecessors of the Calchaqui Indians, who occupied this territory at the Conquest. He suggests that they are the work of the same people who erected the buildings of Tiahuanuco; a suggestion which I think is extremely probable, for some of the decoration shown in his cuts is strikingly like that on the stone pillars of Hatuncolla, two leagues from Lake Titicaca, portrayed in Squier's 'Peru,' pp. 385–6.

ETHNOGRAPHY OF THE MYCENEANS.

In the excellent volume on Mycenean art from the pens of Professors Tsountas and Manatt there is a chapter devoted to the ethnic affiliations of the peoples who, some two milleniums before the Christian era, developed that remarkable culture.

Their tombs, dwellings and arts point to

two different strata of growth, but both purely and originally European and Grecian. The influence of the Orient was late and slight. The two early migrations may be called Danaan and Achæan; but the chief fact remains that they were both of indigenous cultural development, not imported or exotic.

What is more, the later, historic Greeks directly inherited this culture, as is proved by the identity or close similiarity of architecture, ornament, pottery, arms, and religious and political institutions. This also is asserted by Homer and all early Greek tradition.

The linear and hieroglyphic writing, scantily represented in the Mycenean horizon, may point to Asiatic fonts; rather Anatolian (Hittite) than Phœnician; but the evidence is too slight to speak finally on this question.

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NOTES ON INORGANIC CHEMISTRY.

A PAPER was recently read before the Royal Society, by Dr. W. A. Tilden, on the gases enclosed in crystalline rocks and minerals. From the time of Brewster, observers have found in many crystallized minerals, notably in quartz, cavities containing gas, and often drops of liquid. Water, carbon dioxid, hydrocarbons and nitrogen and, more recently, hydrogen and carbon monoxid have been found. A large number of crystalline rocks—granite, gneiss, basalt, etc.—have been examined by Dr. Tilden, and the yield of gas varied from 0.65 volumes, in a recent (1760) lava from Vesuvius, to 17.8 volumes, in a gneiss containing corundum from Serringapatam. The gas is apparently contained in cavities which are visible in thin microscopic sections, but that these cavities are extremely minute is shown by the fact that there is practically no diminution of yield when the rock has been reduced to a coarse powder before heating. The largest portion of the gas is carbon dioxid and hydrogen, with nitrogen, methane, and carbon monoxid, each to the extent of a few per cent. In no case was any evidence of helium found. The presence of hydrogen and carbon monoxid is accounted for by the formation of the rock in an atmosphere rich in steam and carbon dioxid, which was or had been in contact with an easily oxidizable substance; this might be metallic iron, which has been found in basalts and other rocks. The presence of marsh gas in the rocks tends to support the view that in the interior of the earth's crust there are large masses, not only of metal, but compounds of metals, such as iron and manganese, with carbon. This view, first put forth by Mendeleef, which would account for the great deposits of natural gas, petroleum and other natural hydrocarbons, appears to be steadily gaining ground, and has received further support by the work of Moissan and others on the metallic carbids.

MAURICE DE THIERRY communicates to the *Comptes Rendus* determinations of atmospheric ozone on Mount Blanc, begun in 1894. At Chamounix the amount of ozone was 3.5 mg. per 1,000 cubic meters of air; on the Grand Mulets (elevation 3,020 meters), 9.4 mg., or nearly four times as much as at Paris. The conclusion is drawn that the amount of ozone increases with the elevation, a confirmation of earlier results. Hail, falling at an elevation of 4,200 meters, when placed on a sheet of iodo-starch ozonoscopic paper gave immediately circular violet spots of larger diameter than the hailstones and paler in the center, but it was not determined whether these spots were due to an atmosphere of ozone surrounding the stone, or to hydrogen dioxid from the melting hail. Neighboring snows, however, have never shown a reaction for hydrogen dioxid.

The Journal of the College of Science, Imperial University, Japan, quoted in the *Chemical News* for April 9th, gives the full description of the atomic weight determination of tellurium by Masumi Chikashige, already noticed in Science. Previous determinations have been made from tellurium associated with heavy metals, and the figure found, 127.6, is higher than that of iodin, below which it should be, according to the periodic law. It has been thought that some impurity of higher atomic weight might account for the anomaly. Chikashige worked with a tellurium of a wholly different (Japanese) origin, occurring associated with sulfur and selenium. He also reaches the same result, 127.6. It may, however, be noted that if the supposed contamination in the American and European tellurium be due to a higher element of the sulfur group, it would not be unnatural to suppose the same element present in the Japanese mineral, which contains 99.75 per cent. sulfur, 0.06 per cent. selenium, and 0.17 per cent. tellurium.

J. L. H.

ASTROPHYSICAL NOTES.

In *Circular No. 12* of the Harvard College Observatory, dated November 2, 1896, Professor Pickering published the discovery on the Draper Memorial photographs of a remarkable stellar spectrum, that of Zeta *Puppis* (Mag., 2.5; R. A., 8^h 0.1^m; Dec., $-39°$ 43′).

In addition to dark hydrogen lines and *K*, there were two broad bright lines at λ 4633 and 4688, and a peculiar series of dark lines whose wave-lengths were rhythmically related. These were λ 4544, 4201, 4027, 3925, 3859, 3816 and 3783. It was at first thought that they represented some new element not yet found on the earth or in the stars. *Circular No. 16*, of date January 12, 1897, announced, however, the important discovery that these lines are very probably due to hydrogen, being produced under conditions of luminosity not hitherto known. Professor Pickering finds that by writing Balmer's formula, connecting the wave-lengths of the hydrogen lines, in the form

$$\lambda = 3646.1 \frac{n^2}{n^2 - 16}$$

the ordinary lines will be given when for n the even integers 6, 8, 10, etc., are substituted, and the new lines when the odd integers from 9 to 21 are successively assigned to n. It appears that the lines for $n = 7$ (λ 5412), 9 (λ 4544), 11 (λ 4201) and 13 (λ 4027) have been hitherto recorded in certain spectra of type IIb. Professor Pickering has since reported that three other southern stars are somewhat similar to Zeta *Puppis* in having part of the lines of the new series.

Meanwhile Professor H. Kayser, of Bonn —whose work in conjunction with Professor Runge on the harmonic relations of spectral lines is so favorably known—also investigated the origin of the new lines, and publishes his conclusions in two articles in the *Astrophysical Journal* for February and April. Hydrogen had been the only element having harmonically related lines which had possessed only a single series of such lines. Now Kayser and Runge have found that two of the series of lines for an element end at nearly the same place. Hence on examining the frequencies of the new lines, Kayser concluded that they have this characteristic and represent a new hydrogen series, a conclusion confirmed in his second article written after seeing *Circular No. 16*. Thus the spectral relations of hydrogen lines become normal.

It is a matter of much interest to know if the lines of the new series can be produced in laboratory experiments. If so, important information as to stellar temperatures and pressures is likely to be o btained

THE Lick Observatory has just sent out Plates 2 to 5 of its *Observatory Atlas of the Moon*, finely reproduced in photogravure, on a scale of 38 inches to the lunar diameter, from the negatives obtained with the great refractor. The publication of this valuable series of photographs was made possible by the generosity of a citizen of New York, Mr. W. H. Law.

IN the *Monthly Notices* of the Royal Astronomical Society for January Mr. W. F. Denning contributes a catalogue of the real paths of 107 meteors, observed by himself and others in England during the last ten years. The averages are:

Height at first appearance	73.6 miles	(106 meteors)
Height at disappearance	45.3 "	(107 meteors)
Length of path	62.1 "	(105 meteors)
Velocity per second	26.9 "	(58 meteors)

The greatest height of any well-observed meteor was 126 miles. In the above averages no distinction was made between fireballs and shooting-stars.

IN the same number of the *Notices* Professor G. von Neissl, of Brünn, contributes a list of the real paths of 100 large meteors which have been authentically observed, chiefly in the last two decades. For these the average height when first seen was 91 miles. No. 77 of the list was visible from Servia to France, traveling in a real path of 1770 miles, from the hardly credible elevation of 483 miles to that of 115 miles. From a comparison of the catalogues of von Neissl and himself, Denning shows several instances of the recurrence of large meteors from the same radiant, indicating that they belonged to the same swarm.

E. B. F.

SCIENTIFIC NOTES AND NEWS.

MISS ALICE BACHE GOULD has given $20,000 to the National Academy of Sciences as a memorial to her father, the great astronomer, B. A. Gould. It will be known as the Gould fund and the income will be used to promote researches in mathematics and astronomy.

SIR HENRY THOMPSON has presented the Royal Observatory at Greenwich with a telescope said to be the most powerful instrument at present existing for the prosecution of astronomical research by means of photography. The photographic refractor has an object glass 26 inches in diameter. The photographs it will take will be on twice the scale of 2 mm. to one minute of arc, and its short focal length gives it great light-gathering power. The instrument now mounted at Greenwich has been in course of construction by Sir Howard Grubb, of Dublin, during the last three years.

THE Royal Observatory at Bonn has received from the state a preliminary appropriation of 30,000 Marks, which will ultimately be increased to 90,000 Marks, for the construction and mounting of a refracting telescope of medium size.

SIR WILLIAM FLOWER'S term of office as Director of the Natural History Departments of the British Museum has been extended for three years from the expiration of his retirement date under the age regulation of the Civil Service.

THE American Philosophical Society, Philadelphia, will hold a conversazione in honor of Sir Archibald Geikie on the evening of May 7th. Sir Archibald Geikie will make a communication on recent geological work in the Hebrides and Faroe Isles.

THE Council of the British Medical Association has conferred the gold medal of the Association on Mr. C. G. Wheelhouse and Sir Walter Foster.

THE Cothenius medal, *Leopold Carolinische Akademie der Naturforscher*, has this year been awarded to Dr. G. Quincke, professor of physics at Heidelberg.

DR. P. GRÉHANT, professor of physiology in the Paris Museum of Natural History, has been awarded 4,000 francs by the French government to promote his researches on the applications of physiology to hygiene.

MR. J. H. PRATT, instructor of mineralogy in the Sheffield Scientific School of Yale University, has accepted the post of mineralogist in the North Carolina Geological Survey.

M. PICOU was elected president and M.

Gosselin secretary of the *Société Internationale des Electriciens* at the last meeting of the Society held on April 7th.

Dr. Traill Green, emeritus professor of chemistry at Lafayette College, died at Easton, Pa., on April 29th, at the advanced age of eighty-four years. Dr. Green was first made professor in Lafayette College sixty years ago, and during that time took an important part in the building-up of the college, having been dean of its scientific department and having given it an astronomical observatory. He made many contributions to medicine and to other sciences.

We regret further to record the death of Miss Emily L. Gregory, professor of botany at Barnard College and the author of valuable contributions to botany, and also the deaths of Dr. de Marbaix, founder of the Bacteriological Institute at Boma; of Dr. Jakob Breitenlohner, professor of meteorology and climatology in the Vienna School of Agriculture; of Dr. Sinku Sakaki, professor of psychiatry in the University of Tokio, and of Dr. Victor Lemoine, formerly professor of the Medical School at Reims, and known for his contributions to comparative anatomy and paleontology.

Longmans, Green & Co. are about to publish a new and revised edition of Sir John Evans' 'Ancient Stone Implements, Weapons and Ornaments of Great Britain,' which has long been out of print.

The London *Academy* is publishing a series of portraits of eminent writers. The issue of April 10th contained an admirable reproduction of a photograph of Darwin, by Mrs. J. M. Cameron.

The British government authorities have presented Dr. Nansen, in recognition of his services in scientific exploration, with a complete set of the Challenger Reports. This is said to be the only case in which this great publication, extending to fifty volumes quarto, has been presented to an individual.

Dr. Carl Lumholtz, the Norwegian anthropologist, has returned to New York after having spent three years in the interior of Mexico in the interests of the American Museum of Natural History. He has secured valuable collections and much information regarding the aboriginal tribes.

It is stated in *Nature* that at the last meeting (April 14) of the Russian Geographical Society, Baron Osten Sacken read a telegram which he had received from Sven Hedin, the well-known Swedish traveler in Central Asia, announcing that he had crossed Tibet (Northern Tibet) by following a route which lies somewhat to the south of General Pyerstoff's route; during that journey he discovered 23 new salt lakes, four of which are of considerable size. Notwithstanding the great difficulties of the journey, and the loss of 44 beasts of burden out of 50, all collections are safe. From Tibet, Sven Hedin went through Mongolia to Pekin, and towards the end of May he expected to be in St. Petersburg.

M. Augustin Falconz has given the University of Lyons 100,000 francs to be used for biennial prizes, one for each of the four faculties of the University.

A chair of physical geography has been established in the faculty of sciences in the University of Paris, and M. Vélain has been appointed the first incumbent.

A memorial proposing a physical laboratory for India signed by Lord Kelvin, Lord Lister and other leading British men of science has been presented to the Secretary for India. The memorial is as follows:

"We, the undersigned, interested in the progress of physics, desire respectfully to draw your lordship's attention to the great importance which we attach to the establishment in the Indian Empire of a central laboratory for advanced teaching and research in connection with the Presidency College, Calcutta, the most important educational institution under the Government of India. We believe that it would not only be beneficial in respect of higher education, but also that it would largely promote the material interests of the country, and we venture to urge on you the desirability, therefore, of establishing in India a physical laboratory worthy of the great empire."

Professor D. T. MacDougal, in a letter to the *Botanical Gazette*, on the Tropical Laboratory Commission, states that Dr. J. E. Humphrey, accompanied by a number of advanced students in zoology from the Johns Hopkins

University, will carry on some investigations in the vicinity of Port Antonio, Jamaica, during the ensuing season, and that he has agreed to cooperate with the Commission in the examination of the island. In the arrangement of plans for the work of the Commission provision will be made for a repetition of a portion of the tour of investigation during the coming winter, in order to appreciate more fully the climatic possibilities of the more promising localities. The *Journal of Botany*, in an article expressing cordial approval of the undertaking, advocates one of the Lesser Antilles as the site of the laboratory, urging that a site in Mexico would be a hindrance to cooperation on the part of botanists in Great Britain on account of the length of the journey.

THE Friday evening meetings of the Royal Institution of Great Britain were resumed on April 30th, when Professor J. J. Thomson gave a discourse on 'Cathode Rays.' Succeeding discourses will probably be given by Professor Harold Dixon, the Right Hon. Lord Kelvin, Professor H. Moissan, Mr. W. H. Preece, Mr. William Crookes and others. The Tyndall lectures for 1897 are being given by Dr. Tempest Anderson, his subject being 'Volcanoes.'

THE Royal Society will hold the first of its two annual conversaziones on the evening of May 19th.

THE ninety-fifth anniversary of the founding of the Zoological Station at Naples was celebrated on April 14th. Addresses were made by Professor Todaro, representing the University of Rome and the Accademia dei Lincei by Dr. Eisig, of the Station; by Professor Waldeyer, representing the Berlin Academy of Sciences, and by Professor His, of Leipzig. Professor Dohrn was presented with the freedom of the city of Naples and the Grand Cordon of the Crown of Italy. After the German Ambassador had made a few remarks Professor Dohrn himself gave an account of the origin and progress of the laboratory whose work has been such an important factor in the progress of biological investigation.

SEVERAL members of the British Royal Commission on Tuberculosis, including Sir Herbert Maxwell, M. P. (Chairman), Mr. Harcourt E. Clare, Mr. John Speir and Mr. T. M. Legge (Secretary), accompanied by Professor M'Fadyean, started on April 22d for Brussels, Cologne, Berlin and Leipzig, in order to investigate the methods adopted on the Continent for dealing with tuberculosed meat. The Belgian and German Governments have made arrangements to aid the Commissioners in the investigations. The Commissioners expect to return about the end of the second week in May.

INVITATIONS have been sent for the sixty-fifth annual meeting of the British Medical Association, to be held at Montreal. The program is as follows: August 31st, 12 a. m.—Services in the English Cathedral. 2:30 p. m.—Windsor Hall, opening ceremonies and addresses of welcome. 8 p. m.—Address by the President-elect, T. G. Roddick, M.D., M.P. 4 p. m.—Garden parties, excursions around the mountain, etc. 9 p. m.—Soirée at Laval University. September 1st, 1. p. m.—McGill University, openings of sections (eleven in all). 3 p. m.—Windsor Hall: Address in medicine, by Dr. Wm. Osler. 4. p. m.—Excursion down the St. Lawrence, etc. 9. p. m.—Sohmer Park, conversazione and dance. September 2d, 9:30 p. m.—McGill University, sectional meetings. 1:30 p. m.—Lunch on the mountain. 3:30 p. m.—Windsor hall, address in surgery, by Mr. T. Mitchell Banks. 4:30 p. m.—Excursion across the Island, etc. 7:45 p. m.—Annual dinner of the Association, Windsor Hall. September 3d, 9:30 a. m.—McGill University, sectional meetings. 3 p. m.—Windsor Hall, address in public medicine by Herman M. Biggs and concluding general meeting. 4:15 p. m.—Excursion to St. Anne's and down the Lachine Rapids. 9 p. m.—Soirée at McGill University. September 4th.—Excursion to Ottawa, Quebec, Kingston, St. Agathe, Lake Memphremagog, etc.

CAMBRIDGE UNIVERSITY has made a slight provision for the study of experimental psychology, but the science is very inadequately represented in Great Britain as compared with Germany, the United States and France or even with countries such as Russia, Switzerland, Italy, Belgium and Denmark. We are glad to learn that an effort is now being made to intro-

duce the subject into University College, London. A committee, including Mr. Francis Galton, Professor Carl Pearson, Professor C. A. Schäffer and others, has been formed and subscriptions are invited for the purchase of apparatus and the establishment of a lectureship.

In an interesting historical sketch of the University of Minnesota, Professor C. W. Hall describes an important adjunct of the scientific work of the University—the Geological and Natural History Survey of the State. This was organized in 1872 and placed under the direction of the Board of Regents. The original cost of this work was $1,000 per year; this was soon increased to $2,000, and in 1875, and subsequently, 38,643 acres were turned over to the Regents to be disbursed in accordance with the law ordering the Survey. This land, at the minimum price of $5.00 per acre, for which it could be sold, will eventually enable the Regents to realize over $200,000. The cash appropriations which the State has at various times voted for the maintenance of this work amount at date to $50,000, not including cost of printing. The Survey is comprehensive in its scope. The fields of investigation named in the original act are geology, botany, zoology and meteorology. Two maps, a geologic and topographic, were also provided for; the latter, on approval, to become the official map of the State. A museum was also contemplated, which should exhibit to the people of the Commonwealth, in an orderly and scientific way, its natural resources as discovered by the Survey. The geological exploration of the State was first prosecuted. Botany, zoology, meteorology and topography are to follow in order, unless economy and efficiency can be secured by joint operations. The results of these investigations thus far available are to be found in a series of annual reports covering almost a quarter of a century of geologic work; three volumes on the final report of the geology of State; two brief reports of the State Zoologist, accompanied by a study of the birds of Minnesota, by Dr. P. L. Hatch, and a synopsis of the Entomostraca of Minnesota, by C. L. Herrick and C. H. Turner; one report of the State Botanist, containing an exhaustive review of the Metaspermæ of the Minnesota river valley; a series of bulletins, containing geological, botanical and zoological papers, besides many scientific papers from less comprehensive fields of study.

The *Electrical World* reports on a recent communication by M. d'Arsonval to the Société Internationale des Electriciens concerning the therapeutic and physiological effects of high frequency currents. He showed the powerful inductive effects which can be obtained with these currents. A striking experiment consists of placing three lamps in tension and allowing the current to pass through the body. These currents cause no sensations, and a man placed in a circuit does not feel that he is traversed by the currents which brilliantly illuminate the lamps. The principal results of this electrification are an augmentation of the oxidations in the organism and an increase in the production of heat. A subject who, under ordinary conditions, eliminates 17 to 21 liters of carbonic acid per hour throws off 37 liters after having been submitted to this action. High-frequency currents do not act solely upon the surface of the body, but also profoundly upon the interior. All of these results have been obtained upon a number of subjects by MM. Apostoli and Charrin. M. d'Arsonval cited, in closing, the action exercised upon microbes and bacteria by these currents. The microbes and bacilli are modified, and the toxines are killed and transformed to vaccine. MM. d'Arsonval and Charrin hope by this method to arrive at a direct treatment for the interior of the bodies of patients suffering with zymotic disease, and experiments to this end have begun.

We are extremely glad to note that the tariff bill, as amended by the Senate Finance Committee, includes the following additions to the free list:

Books, maps, music, engravings, photographs, etchings and charts, printed more than twenty years before the date of importation; all hydrographic charts and scientific books devoted to original scientific research, and publications issued for their subscribers by scientific and literary associations, or publications of individuals for gratuitous private circulation, and public documents issued by foreign governments.

Books printed exclusively in foreign languages for the blind.

Books, maps, etc., especially imported, not more than two copies in any one invoice, for the use of any society or institution established solely for religious, philosophical, educational, scientific or literary purposes, or for the encouragement of the fine arts, or for the use of any college, school or public library, and not for sale.

Paintings, original drawings and sketches, engravings and statuary, not otherwise provided for; paraffine, philosophical and scientific apparatus for schools, libraries and societies; professional books, implements and instruments, and tools of trade or occupation in the actual possession at the time of persons arriving in the United States; regalia and gems, statues, casts of marble, bronze, or alabaster, where specially imported in good faith for the use of any society, school or library.

UNIVERSITY AND EDUCATIONAL NEWS.

THE will of the late John Foster, of Boston, gives $120,000 to public purposes, including $10,000 to the Massachusetts Institute of Technology.

THE will of the late Charles Bell, of Springfield, Mass., bequeaths $7,000 to Wellesley College for a scholarship fund.

BROWN UNIVERSITY receives $10,000 by the settlement of the will of the late Mrs. Maria L. Benedict, of Providence.

PROFESSOR H. L. HUTCHIN, Dean of the Law Department of the University of Michigan, has been offered the presidency of the University during President Angell's absence in Turkey.

MR. C. H. WARREN has been appointed instructor in mineralogy in the Sheffield Scientific School of Yale University.

THE Spanish universities and other educational institutions under state control have just been thrown open to foreigners by royal decree. By the new ordinance foreigners are admitted to the right of matriculation, study and examination in all educational establishments under the Spanish government, and are entitled to take degrees in the universities.

IN announcing last week the promotion of Professor Albert Bushnell Hart, of Harvard University, it was accidentally stated that his chair was physics; it should, of course, have been history.

DISCUSSION AND CORRESPONDENCE.

TYPE SPECIMENS IN NATURAL HISTORY.

A RECENT number of SCIENCE* contains an article by Mr. Charles Schuchert, entitled 'What is a Type in Natural History?' The title is misleading, for, instead of discussing type forms or types of groups, Mr. Schuchert confines his attention to type specimens, and chiefly to the names by which such specimens may be designated, in which direction he shows remarkable fertility of resource. In view of these facts, and of the additional circumstances that the subject is approached from the standpoint of the student of fossils, his paper might have been better described under some such heading as 'Suggestions for the Multiplication of Type Specimens in Paleontology.'

Mr. Schuchert revives several obsolete terms, such as *paratype* and *metatype*, which have never been used, so far as I am aware, even by the man who proposed them, and adds a number of his own invention, such as *genotype*, *holotype*, *hypotype*, *plastotype* and *hypoplastotype*. These may be taken as mild examples of a prevalent and apparently incurable form of mania which busies itself in burdening science with a useless and formidable terminology. The most serious objection to such terms is the discouraging effect they have on students, for they wall in a subject with a barrier that few have the courage to assail. In my own case I am bound to confess that, although the greater part of my life has been spent in the study of animals and plants, I am to-day unable to read half the literature on these subjects, because of the multiplicity of technical terms by which the author's meaning is made unintelligible. Life is too short and too precious to be fritted away in memorizing such a disheartening and ever increasing mass of terminology.

My reasons for replying to the article in question are, first, to make the occasion an excuse for filing a protest against the unlimited coinage of new terms, and second, to assure the amateur and beginner that in descriptive zoology and botany these particular terms are wholly unnecessary. In practice the best systematic

* SCIENCE, N. S., No. 121, pp. 636-640, April 23, 1897.

writers find the single word *type*—understood the world over—sufficient for ordinary needs. But in cases where a species rests on more than one specimen, and the author neglected to indicate a type, the term *cotype* is used to designate each of the several specimens on which the original description was based. Still another term is found convenient and is in common use among mammalogists. It is the word *topotype*, proposed by Mr. Oldfield Thomas, and used to designate a specimen from the identical locality from which the type specimen of a species came. Among plants and non-migratory terrestrial animals, topotypes are, after the original types, the most valuable study material a museum can possess.

In paleontology, where it is customary to describe new species from very fragmentary material—such as the tooth of a mammal or the leaf of a plant—which is afterwards supplemented by the discovery of additional parts, it becomes convenient, as pointed out by Mr. Schuchert, to consider the later and more perfect specimens, from which additional characters are derived, as *supplementary types*. This, however, hardly seems sufficient provocation for the introduction of a special set of new terms. Nevertheless, if paleontologists really feel the need of these terms I suppose the rest of us should try to bear them with becoming fortitude; but would it be too much to ask that they be considered as proprietary material and not let loose on the whole field of systematic biology?

It is pleasing to note that Mr. Schuchert is a firm believer in the priceless value of type specimens and that he advocates the use of special colored labels to distinguish them from others. Fortunately the use of such labels for this purpose is rapidly becoming general. It might be added that as a rule type specimens should not be placed in the exhibition series in public museums, but should be carefully preserved in special cases devoted exclusively to such material. The exhibition in glass cases of type specimens of animals injured by light—as birds and mammals—indicates a disinterestedness amounting almost to criminal neglect.

While discussing the matter of types I would like to digress sufficiently to express the conviction now shared by a large body of working naturalists that type specimens, being units of comparison, should from the nature of the case be single, not multiple. It is the common experience of naturalists that in a considerable percentage of the cases where several specimens have been used as types, subsequent study has shown these specimens to belong to different species, and in some cases to different genera. Is not this fact alone an unanswerable objection to the existence of more than one type specimen of a species?

C. Hart Merriam.

SCIENTIFIC LITERATURE.

Spencer's Principles of Sociology. New York, D. Appleton & Co. 1897. Volume III., pp. x +645.

This volume completes not only Mr. Spencer's great work on 'The Principles of Sociology,' which in itself is an undertaking quite sufficient to establish the permanent reputation of any one man; but also the system of 'Synthetic Philosophy,' which was begun more than thirty-six years ago, and has been carried forward under circumstances of extraordinary difficulty. The system as it now stands in its final form includes the volume entitled 'First Principles,' in which the general doctrine of evolution is formulated in abstract terms; two volumes on 'The Principles of Biology,' two on 'The Principles of Psychology,' three on 'The Principles of Sociology' and two on 'The Principles of Ethics.'

No other mind in our generation has attempted to grapple so seriously with so many great subjects as Mr. Spencer has done; no other one thinker has so impressed himself upon all serious investigators in each of the great branches of scientific knowledge. Very few professional biologists are more frequently quoted than Mr. Spencer in works on biology; few, if any, professional psychologists are so frequently quoted in works on psychology; few, if any, professional writers on ethics are so frequently quoted in discussions of morals. This one fact is a significant index of Mr. Spencer's range and power. Even if it be true that the expert in each of the sciences mentioned disagrees with Mr. Spencer's conclusions on vital points, it is an astonishing achieve-

ment for any one man to have so impressed himself upon the best thought in so many fields of mental activity that all whose life work is concerned with these subjects find it necessary to define their relations to one such comprehensive thinker.

Of Mr. Spencer's 'Principles of Sociology' it must be said, first, that it should not be judged with reference to any conclusion that the critic may have reached upon the question whether or not there is a science of society. The phenomena of society are the most complex and perhaps the most elusive with which a serious student can deal. It may be that scientific opinion will presently be practically unanimous that no laws of social causation can be formulated which can be placed in the same category with those laws that make up the physical sciences. It will not follow, however, that society cannot be studied in a scientific spirit and by scientific methods. Whether or not, then, Mr. Spencer has created a science of sociology, he has at least demonstrated that social phenomena can be studied with scientific seriousness, and that if we do not thereby establish positive laws of social causation we shall, at least, attain to broader and truer views of social organization, of our personal relations to our fellow men and of the expediency of various schemes of governmental policy.

Of the wealth of illustration, the enormous array of facts which Mr. Spencer has brought together in these volumes, it is desirable to say that they have been made the subject of some unjust criticism. It is true that Mr. Spencer has depended upon the reports of travelers, explorers and missionaries for the greater part of his material; it is true that the observations so obtained have not always been made with critical discernment; but, on the other hand, it is to be remembered that comparatively little work has ever been done in sociological observation by trained observers. The test, therefore, that should be applied to Mr. Spencer's data is the question: "Has he on the whole made a discriminating and critical use of such material as was available?" When judged by this standard, Mr. Spencer's work in sociology will be found to be above the average level of treatises on anthropology and ethnology.

It is not necessary to speak in detail of Mr. Spencer's analysis of social organization or of his interpretation of social progress, as these things have become already familiar to the general reader. The organization of society, like that of the plant or of the animal, becomes complex through differentiations of activities and of groupings; it becomes unified through the integration of small communities into great nations. Social change, on the whole, is a progress from homogeneity to heterogeneity, in both activity and organization. Another point, however, and the one which is really vital in Mr. Spencer's philosophy of human relations, may be emphasized, because it is too often overlooked. Mr. Spencer does not admit that human nature is unchanging. Character, like everything else, undergoes a progressive modification. The environment and circumstances of a community are the environment of the individual character. Under conditions favoring industry and peace human nature develops the virtues of gentleness, truthfulness and industry; under conditions necessitating prolonged or chronic warfare human nature becomes cruel, tyrannical or subservient, untruthful, all that is vicious. This contention is maintained in all of Mr. Spencer's sociological writings, and is the chief proposition of 'The Principles of Sociology,' recurring again and again in the successive parts on Domestic, Ceremonial, Political, Ecclesiastical, Professional and Industrial Institutions.

Mr. Spencer's final conclusions, as he surveys the civilized world at the present moment, are somewhat despondent. He sees everywhere the revival of the military spirit and he looks for a marked deterioration of individual and national character in the immediate future. Of the more distant future, however, he expects better things, and at the conclusion of his work he renews the prediction which he made nearly fifty years ago: "The ultimate man will be one whose private requirements coincide with public ones. He will be that manner of man who, in spontaneously fulfilling his own nature, incidentally performs the functions of a social unit, and yet is only enabled so to fulfil his own nature by all others doing the like."

FRANKLIN H. GIDDINGS.

The Crowd. A Study of the Popular Mind. By Gustave Le Bon. The Macmillan Co.

This is a translation of a little volume entitled 'Psychologie des foules,' which appeared in Paris in 1895. The author is well known in the European scientific world as a voluminous writer upon many branches of physiology and psychology, and in recent years more especially as a student of the psychology of races and of mankind as socially organized.

In the present work M. Le Bon devotes his attention to an analysis of the psychological phenomena of masses of men. The substitution of the unconscious action of crowds for the conscious activity of individuals, he tells us, is one of the principal characteristics of the present age. The epoch is one of those critical moments in which the thought of mankind is undergoing a process of transformation. The general destruction of those religious, political and social beliefs which were the elements of an earlier civilization has been succeeded by new intellectual conditions of existence, the product of scientific thought and industrial discoveries In this critical transition period we are witnessing also the transformation of social organization from monarchical and aristocratic forms to democracy. Our author declares that we have entered, or we are about to enter, upon an age that may truthfully be described as the era of crowds. While only two generations ago the opinion of the masses scarcely counted in political affairs, to-day it is the old traditions and the opinions of individuals that are without influence. The voice of the masses has become preponderant.

What effect is this rule of the crowd to have upon civilization? In the past, civilizations have been created and directed by a small intellectual aristocracy, never by the crowd. Crowds, thus far in the world's history, have been powerful chiefly for destruction. Obviously, before we can answer any question in regard to the probable future action of crowds, we shall need to know much more of the psychology of collective men than we know at present. The thoughtful public should be grateful to M. Le Bon for this first serious attempt to analyze the mind of the crowd. One need not accept all of his conclusions to appreciate the value of his work. Its importance consists in the fact that he has clearly stated a large number of problems which merit diligent consideration—problems which hitherto have not been seriously studied as the foundation of political science.

The starting point of M. Le Bon's philosophy of crowds is a conviction that the crowd is always something more than the sum or the average of its individual elements. Our author believes that when men become organized as a crowd they lose many of their individual characteristics and acquire others which, as individuals, they never exhibit. The crowd is always, according to M. Le Bon's observations, swayed by feeling rather than by reason. This is because men differ more widely in intelligence than in feeling. The mental unity of a crowd, therefore, is sympathetic rather than rational. Again, crowds are undoubtedly to a very great extent subject to suggestion and to hypnotic influence. So far as the mental operations of crowds are intellectual they think in images, and are therefore in a large measure controlled by imagination. Like children, crowds are impatient of any obstacle interposed between suggestion and act; they desire to carry a purpose into immediate effect. They are, therefore, intolerant of discussion and of delay.

These truths, M. Le Bon declares, have always been instinctively apprehended by men with a genius for leadership. The imagination of crowds is awakened by whatever presents itself in the shape of a startling and effective image, freed from all accessory explanations. The leader, therefore, will take care to lay things before the crowd as a whole, and will carefully avoid any attempt to justify them on grounds of reason or to explain their origin. No man ever so thoroughly understood this truth as the first Napoleon. "It was by becoming a Catholic," he said to the Council of State, "that I terminated the Vendéean war; by becoming a Musselman that I obtained a footing in Egypt; by becoming an Ultramontane that I won over the Italian priests, and had I to govern a nation of Jews, I would rebuild Solomon's temple."

In general, crowds are powerless to hold other opinions than those which are imposed upon them by example or authority, and are not to be controlled by rules based upon theories of

pure equity or of economic expediency. They are rather to be directed, if at all, by seeking what produces an impression on them and what seduces them. The danger to civilization in this psychology of crowds lies in the fact that the dogmas whose birth we are now witnessing will soon have the force of old dogmas, that is to say, the tyrannical and sovereign force of being above discussion. The divine right of the masses is about to replace the divine right of kings. Nevertheless, M. Le Bon affirms that it would be dangerous to meddle with the organization of crowds, notwithstanding their psychological inferiority. The facts of history have demonstrated that social organisms are every whit as complicated as those of all beings, and it is not in our power to force them to undergo any sudden or far-reaching transformation.

M. Le Bon's account of the general psychology of crowds is supplemented by a detailed analysis of more special characteristics, in separate chapters on the sentiments and morality of crowds, the ideas, reasoning power and imagination of crowds, the religious shape assumed by the convictions of crowds, and the immediate factors of the opinions of crowds. In the latter part of his volume he describes different kinds of crowds, including criminal crowds, electoral crowds and parliamentary assemblies.

The chief criticisms to be passed upon this volume are: First, that the author has not acknowledged, as he should have done, his very obvious indebtedness to the greatest living social psychologist, M. Tarde, whose 'Les Lois de l'imitation' and 'La logique sociale' contain in their original form many of the suggestions which have governed M. Le Bon's thoughts. Second, that he makes rather too much, probably, of what he would call the hypnotic phenomena of crowds, and too little of the absence of personal responsibility which the individual feels when he unites with his fellowmen in collective action.

FRANKLIN H. GIDDINGS.

Laboratory Practice for Beginners in Botany. By WILLIAM A. SETCHELL, PH. D., Professor of Botany in the University of California. New York, The Macmillan Company. 1897. Pp. xiv+199. Price, 90 cents.

There are already a number of laboratory guides in elementary botany and, judging from the announcements of book publishers and their statements in conversation, there are soon to be several others. Their multiplication only argues that no single outline will satisfy other teachers. No good teacher can follow closely the outlines of instruction laid down by another; each must throw his own personality into the work and the method, and the conditions of time, place and facilities for work will all enter into the problem of how to teach an introductory class in botany. The author of the work in hand recognizes this condition when he says (p. 137): "The ideal way is to teach the student without any book."

The book illustrates what we regard as a false principle of instruction, though one much in vogue, namely, the telling a pupil in advance to see certain things before he has had a chance to look for something himself; this, followed too closely, can only result in preventing the development of any originality in the pupil and tends to reduce him to a mere machine. To illustrate the method followed, we quote from one of the chapters:

"I. Take a piece of stem of the Japanese Quince, which has several leaves attached to it. Examine the leaves and notice that:

"1. They are all borne on the sides of the stem (*i. e.*, that they are *lateral structures*).

"2. They are broad and thin (*i. e.*, they are also *expanded structures*).

"3. Their color is green. (This is not true for all leaves, *e. g.*, examine the leaves of some common red Colias [*sic*] of the garden or greenhouse, in which another coloring-matter is present and hides the green.)

"4. They are all borne at the *nodes* of the stem. (We may consequently separate that portion of the plant above the root into a number of similar parts, each of which may be called a *phytomer* or plant part. Each phytomer will consist of an *internode*, and a *node* with its *leaf* or *leaves*. Sketch a phytomer of the Japanese Quince and label it.")

This criticism is, of course, general, applying to many books of its class that have been

adapted to students of various grades in various subjects. They may be useful for giving suggestions to teachers who are themselves poorly prepared, but are not of the character to be placed in the hands of the beginning pupil. The pupil, to again quote the sentiment of the author, should be taught without books.

Treated, however, as a book for the instruction of teachers, this work possesses many meritorious features, among which we may mention:

1. It outlines work that can be accomplished without the aid of a compound microscope. This is highly important, because many schools cannot be equipped with compound microscopes, and what is a better reason, because a pedagogical one, it will prevent pupils becoming familiar with the compound microscope before they have exhausted the possibilities of the simple one. Botanical perspective cannot be attained by looking down the tube of a compound microscope alone, and the failure to learn how to use the unaided eye or a simple lens has been responsible for some of the lack of perspective in the rising generation of botanists.

2. It emphasizes the ecological side of botany, which is destined to be the next ruling feature of elementary botanical instruction.

3. Its list of required laboratory books for the teacher is short but excellent, and emphasizes the feature last named in such books as those of Kerner and Selina Gaye, and rigidly excludes manuals and other works on systematic botany which belong to a later stage in the evolution of botanical students.

Besides the general criticism given above, which falls on this book only as one of a special class, there are features peculiar to itself that could be improved. For example, it combines, among many suggestions suitable to the age of the pupils for which the work is intended, some that seem infantile and others that savor of pedantry or at least belong to children of a larger growth. Such expressions as 'strophiole,' 'phytomer,' 'reclinate præfoliation' and 'indeterminate anthotaxy,' might well be deferred to a later stage of instruction, if introduced at all. Then the work gives a more fragmentary treatment of the spore-producing plants than would be expected from a specialist in cryptogamic botany, tending, as was the case with Dr. Gray's text-book, on which this is quite closely patterned, to create the impression that all plants produce flowers or at least all that are worth considering. Besides leaving out a half of the plant world, and an important half at that, this plan hides away from the student the great principle of evolution of plant life which would be impressed upon him unconsciously were the study to commence with lower forms or at least give them a fair amount of attention. It is amazing how much knowledge of these lower plants can be gained by means of a simple magnifier, and it is unfortunate, to say the least, to prevent the student, however young, from getting a well-rounded conception of the whole subject. There are some few obsolete expressions in the book like 'stomata or breathing pores' and occasional typographical slips that it is always difficult to avoid in a first edition. On the whole, the merits of the work are much greater than its demerits, and if used by teachers alone, and not by students, it is probably as good or better than most the books of its type.

L. M. Underwood.

Essai critique sur l'hypothèse des atomes dans la science contemporaine. Arthur Hannequin. Annales de l'Université de Lyon. Tome Septième. Paris, G. Masson. 1895. Pp. 419.

This is an interesting and important book of its kind, but it is also a kind of book which to many physicists will need justification. It is a serious attempt to form a philosophy of atomism, and as such will be found to contain too much physics to please most metaphysicians and too much metaphysics to please physicists. That each party in the case may take his own, the book is frankly divided into two parts, the first having to do with atomic theory as actually found in science, and the second with the metaphysics of this theory. But it would be too much to hope that the physics and the metaphysics of atomism had actually been disentangled and separated. Whatever the metaphysician may do the wise physicist will read the whole book if he wishes to get M. Hannequin's complete message.

The book is written in a charming style, picturesque without loss of dignity and vivacious without flippancy. The discussion is at once so orderly and so complete as to give a high impression of unity and elegance. To one interested in the subject the book will prove easy and delightful reading. While we have in English many books upon parts of the field and many special investigations concerning molecular action we have yet no general work like this upon the foundations of atomism. Stallo's Modern Physics comes nearest to it and, although elementary in character and limited in scope, deserves to be better known than it is.

It is easy to see that the main interest of the author is philosophy and yet he shows everywhere wide and thorough reading in the history of atomistics and also in modern physics and mathematics. But with competent knowledge his perspective is often false. Leibnitz, though not better known, seems distinctly nearer to him than Maxwell, and he does not scruple to put down Cantor with a quotation from Descartes. Indeed the book is not only scholarly, but distinctly scholastic. This is perhaps the reason why the author takes everywhere a hard and fast view of science as a fixed body of knowledge instead of the growing, elastic, tentative thing that it really is. Having proved that the universe cannot be explained by the atom of Greek philosophy, a hard, round, indivisible solid, without parts or qualities, he fails to do justice to, although he shows a full consciousness of, modern atomistic speculation. M. Hannequin's statement on page 225, and everywhere implied throughout the book, that "the rigorous unity and the perfect simplicity of an explanation are the highest guarantees of its truth," should be limited to pure science. For experimental science this is an early and naïve view. The universe, and every part of it, is infinitely complex and diverse, and any view that makes it small and plain is the view of innocence, or of one who cares more for method than for matter.

The argument of the book runs in part as follows:

As the mind knows completely only what it creates—knows of things only what it projects into them—so science is rigorous and exact in such measure as it is a creation of the mind. Science takes its rise in the human need of rendering intelligible that which falls beneath the intuition of the senses. Number the mind has created and so knows completely, but extension and direction the mind cannot know directly. It can know these categories only by breaking them up into equal parts and counting them, that is, by *measuring*.

The first step in progress is the reduction of the physics of fact and phenomenon to the physics of law, which in its more generalized form becomes the physics of succession and change. The fundamental change—change of place or motion—turns one side toward fact and the other toward a rigorous mathematic, in terms of which the laws of succession and change are expressed. Thus science becomes universal in motion only as it breaks up its continuity by number. So we triumph over continuity by dividing it into units of time and mass, units small enough to measure any time and any space. These units, *the differentials of mathematics*, are the atoms of pure science—of geometry, of algebra, of kinematics, etc. Thus atomism is a necessary hypothesis growing out of the nature of knowledge.

So far we follow our author mainly with satisfaction, even in his long argument to prove that number and measurement are fundamental in geometry. A straight line is the shortest distance between two points; found shortest by measuring. Other definitions of a straight line he endeavors to reduce to the same notion. But all lines are made up of straight lines, and all figures are bounded by lines, so that all figures bear about with them quantitative relations. To arrive at this conclusion he ignores projective geometry, and discredits transcendental geometry by arguments which are familiar.

But the atom in pure science is a concept, the object of a definition. We must not project it into the real world. So how about atomism in nature? This is, of course, the main theme of the book, and is pursued through the various fields of chemistry, mineralogy, optics, electricity, etc., with intelligence and thoroughness. Mainly he will carry the great body of physicists with him. Sometimes he will part company with them; as when he insists that

the atom must have volume if it has mass, and that equal elementary masses imply equal volumes; when he attempts to disprove the possibility of a vortex atom in a homegeneous fluid; when he tries to prove the conception of atoms as centers of force inconsistent with the idea of mass; and in many details of his argument.

With greater success he exhibits the inconsistency and incompleteness of molecular theory in chemistry; shows the inadequacy of the hypothesis of a single ether or a multitude of ethers to explain action at a distance; of the hypothesis—'that scandal of atomistics'—of molecular atmospheres to explain attraction and repulsion; and, in general, of any hypothesis of an indivisible element to explain elasticity and other properties of matter. He compels us to see that our analysis only draws out of the atom what we have put into it; that, indeed, the atom of modern physics is a little world, almost organized, upon which are assembled all the properties and dynamic relations which it was to have been their mission to explain.

E. A. Strong.

Ypsilanti, Mich.

SCIENTIFIC JOURNALS.

THE AMERICAN JOURNAL OF SCIENCE.

The leading article of the May number is a biographical paper about the late Professor Hubert A. Newton, by J. W. Gibbs. It presents a brief account of his life and estimate of his personal character, and besides gives an extended and thorough summary of his contributions to astronomical science. This paper was read before the National Academy of Sciences at the recent meeting in Washington.

A. G. Webster discusses a method of producing constant angular velocity in cases where a considerable amount of power is needed, as in driving a large telescope or siderostat. It is based upon the use of a tuning fork which interrupts an intermittent current and thus regulates an electric motor. Some experiments show that the method is a practical one up to more than one and a-half horse power. The same author also discusses a method for rapidly breaking powerful electrical currents. The end is accomplished by making the break under water while the mercury surface employed is kept clean by being continuously elevated by means of an aspirated pump. By this means the jet is kept cool and presents a continually fresh surface of mercury, this being washed by the flowing water. The apparatus was found satisfactory in a current of twelve mean ampéres carried on for the course of an hour.

John Trowbridge, following out the line of discussion involved in the paper in the April number, discusses the 'Electrical Conductivity of the Ether.' By the method employed the author thinks he obtains an estimate of the energy required to produce the Röntgen rays and also a measure of resistance of sparks in air and different media. He closes thus: "It shows conclusively that the discharge in a Crookes tube at the instant when the Röntgen rays are being emitted most intensely is an oscillatory discharge. In popular language it can be maintained that a discharge of lightning a mile long under certain conditions encounters no more resistance during its oscillations than one of a foot in length. In other words, Ohm's law does not hold for electric sparks in air or gases. Disruptive discharges in gases and in air appear to be of the nature of voltaic arcs. Each oscillation can be considered as forming an arc. It is well known that a minute spark precedes the formation of the voltaic arc in air. The medium is first broken down and then the arc follows. I believe that this process occurs also in a vacuum and that absolute contact is not necessary to start the arc. My experiments lead me to conclude that under very high electrical stress the ether breaks down and becomes a good conductor."

T. W. Richards and John Trowbridge discuss the effect of great current strength on the conductivity of electrolytes. Experiments were made with copper sulphate and zinc sulphate, and the conclusion is reached that the conductivity is not essentially affected by great changes in the strength of the current.

H. S. Williams has a paper on the Southern Devonian formations, especially in southern Virginia, Tennessee and Kentucky, where he has recently carried on personal observations. He shows the remarkable contrast which exists between the formation as known in New York State and that as developed in the South, where

it is characterized by a uniform black shale with even sedimentation. An hypothesis is advanced to account for this difference and some broad fundamental principles laid down which apply to such problems in general. C. D. Walcott gives a brief description of a new species of *Lingulepis* from the Middle Cambrian, in the Yellowstone Park.

A. W. Duff discusses the secondary undulations of the water surface noted in tidal observations on the Bay of Fundy. At Indiantown, near St. John, New Brunswick, slight fluctuations of level were noted on a calm day, which had a fairly constant period of thirty-five seconds. There was found also a series of larger undulations obtained in the record which had a period of from thirty to forty minutes. Both series ceased at about the same time—about half an hour after high water. In connection with these, the author reviews observations made by various authors on the *seiches*, particularly those of Forel on Lake Geneva. It is shown that Forel's formula gives with fair accuracy the proper period for the secondary undulations, but while the Swiss *seiches* are regarded as connected with the abnormal conditions of the barometer, no such relation appears to exist in the case here described.

S. L. Penfield and H. W. Foote describe a new silicate from Franklin Furnace, N. J., to which they give the name Rœblingite, which is remarkable in containing sulphur dioxide (SO_3) and lead.

THE AUK.

THE April number opens with two papers on the spring plumage of the bobolink, respectively by Arthur P. Chadbourne and Frank M. Chapman, the first being illustrated with a colored plate. Dr. Chadbourne describes a case of the change of color in a caged male bobolink to the spring dress without any loss or renewal of feathers, whereupon he claims that 'color change in the individual feather is fact, not theory,' and that "the change to the breeding dress in the male bobolink sometimes takes place without a so-called 'moult.'" Mr. Chapman's paper is to some extent in the nature of a rejoinder to Dr. Chadbourne's, especially in respect to a specimen of a moulting spring bobolink from Corumbá, Brazil, which Dr. Chadbourne regards as acquiring the breeding dress partly by moulting and partly by change of color in the feathers themselves, an interpretation, which, Mr. Chapman claims, is quite without basis in fact as regards the feathers alleged to be changing color.

Charles W. Richmond describes ten new species of birds from the Kilimanjaro region of East Africa, collected by Dr. W. L. Abbott; A. W. Anthony describes several new birds from Lower California; W. W. Price describes a new pine grosbeak from California, and Leonhard Stejneger a new guillemot from the Kuril Islands. Harry C. Oberholser discusses at length the characters and relationships of the Western forms of the long-billed marsh wren, describing a new subspecies. William Leon Dawson gives an interesting annotated list of the birds of Okanogan county, Oregon; and A. W. Butler writes of various rare birds occurring in Indiana, including an account of the recent remarkable occurrence of Brünnich's murre far inland.

The department of 'General Notes' includes, as usual, a large number of notes on rare or little known species, and a number of important nomenclatural notes; 'Recent Literature' contains sixteen pages of reviews and notices of recent ornithological publications; 'Correspondence' and 'General Notes' complete the number, which is much larger than usual and is filled with matter of unusually varied interest.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—275TH MEETING, SATURDAY, APRIL 10.

DR. THEO. GILL and Mr. C. H. Townsend presented by title, 'Diagnoses of New Species of Deep Sea Fishes.'

Dr. Jonathan Dwight, Jr., under the title, 'A Species of Shearwater (*Puffinus assimilis*, Gould) New to the North American Fauna,' noted the occurrence of this species as a straggler, on Sable Island, on September 1, 1896.

Mr. Sylvester D. Judd spoke on 'Antennal Circulation in Crangonyx.'

Mr. Charles T. Simpson read 'Notes on the Classification of *Unios*,' being a brief sketch of the anatomical work of Lea, Agassiz, Kirtland

and Sterki. The speaker stated that there are two great groups of *Unios* in North America. The first is characterized by different forms of shells and branchiæ in the male and female. The shell of the latter is swollen in the post-basal region, a character wanting in the male, and the outer branchiæ are developed in this region into a marsupium. The shells of this group are generally highly colored, without a ridge on the dorsal slope, not arcuate, have delicate beak sculpture, and the assemblage is no doubt entitled to generic rank, for which the name *Lampsilis*, proposed by Rafinesque and again by Agassiz, may be used.

In the other great group the shells of male and female are essentially alike, being generally dull in color and arcuate in old age, having usually coarse beak sculpture and a posterior ridge. It is not certain that the sexes are always separate. In one subdivision of this group the shells are oval to oblong, and the embryos are contained in the whole of the outer branchiæ; in the other the shells are heavy, short, often tuberculous, and have the embryos generally distributed throughout all four leaves of the branchiæ. This great group is retained in *Unio*, and it is believed that in anatomical characters it closely agrees with the forms of Europe. The Australasian *Unios* are very much like those of South America in shell and anatomical characters and are classed as a separate genus, *Diplodon*. The two naiad faunas may be relics of an older Northern fauna, which was superseded by more modern forms, or it is possible that they may be parts of a Southern fauna that has migrated along a now sunken Antarctic continent.

Mr. Harry C. Oberholser discussed 'the American Golden Warblers,' with particular reference to their geographical distribution. He recognized twenty forms of this difficult group, one-half of which he considered subspecies. The Boreal and Austral regions of North America and Mexico together possess five forms, probably all races of a single species; the Central American subregion of the Neotropical has four; the Columbian subregion four; and the Antillean subregion seven. Various anomalies of distribution were pointed out and commented upon.

Mr. T. Wayland Vaughan gave some 'Notes on a Monograph of the Eocene Corals of the States,' stating that until recently they had not been well understood, although the United States possessed the richest Eocene coral fauna of any country. The original species came almost entirely from the Jackson stage and Lower Claiborne beds, and the material was often so water-worn as to be unrecognizable. Certain genera are well characterized and easily identified; others are so close as to run together. Virginia and Maryland constitute one fauna, containing their own peculiar species; the Gulf States constitute another, while California contains only three species, all endemic. This fauna as a whole belonged to shallow rather than deep water. No species of the American Eocene can be referred to the foreign Eocene.

F. A. Lucas,
Secretary.

AMERICAN CHEMICAL SOCIETY.

A special meeting of the New York section of the American Chemical Society was held at the College of the City of New York on Friday, April 23d. Dr. C. B. Dudley, President of the Society, presided.

Dr. E. K. Dunham, of Carnegie Laboratory, New York, read a paper on 'The Value of Bacteriological Examination of Water.' The discussion was opened by Dr. W. T. Sedgwick, Director of the Biological Laboratory of the Massachussets Institute of Technology. Dr. J. J. Kinyoun, of the United States Marine Hospital Service; Dr. W. P. Mason, of the Troy Polytechnic Institute; Dr. A. R. Leeds, of Stevens Institute, and others, expressed their views and gave testimony to the independence of chemical and bacteriological methods in the study of water supply.

An important point strongly insisted upon by Dr. Sedgwick is the necessity for a personal investigation of the source from which a sample of water is obtained, and he advises the chemist and bacteriologist to refuse to report without personal investigation of the sources of supply.

Durand Woodman,
Secretary.

ERRATUM: P. 658, col. 1, line 25 for *Mesopithecus* read Nesopithecus.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, MAY 14, 1897.

CONTENTS:

On the Distribution of Marine Mammals: P. L. SCLATER.....741

Former Extension of Cornell Glacier near the Southern End of Melville Bay: T. C. CHAMBERLIN..748

Suggestions for a New Method of Discriminating between Species and Subspecies: C. HART MERRIAM..753

The National Academy of Sciences:—

On the Variation of Latitude; The Variation of Latitude at New York and a Determination of the Constant of Aberration from Observations at the Observatory of Columbia University; Notes of Experiments upon the Röntgen Rays.....758

The American Association for the Advancement of Science: F. W. PUTNAM.....760

The Congress of American Physicians and Surgeons..761

Zoological Notes:—

Color Change in the Plumage of Birds unaccompanied by Moult: F. A. LUCAS.....762

Notes on Inorganic Chemistry: J. L. H.....763

Astrophysical Notes: E. B. F.....764

Scientific Notes and News:—

Legislation on the Forest Reservations; The Bequests of the late Professor Cope; General.....764

University and Educational News.....768

Discussion and Correspondence:—

On Supposed Effects of Strain in Telescopic Objectives: ALVAN G. CLARK. *The Loess Formation of the Mississippi Region:* OSCAR H. HERSHEY.768

Scientific Literature:—

Ridgway on Birds of the Galapagos Archipelago: C. H. M. *Wiesbach and Hermann on the Mechanics of Pumping Machinery:* R. H. T.....770

Scientific Journals:—

The Journal of Comparative Neurology.....773

Societies and Academies:—

Chemical Society of Washington: V. K. CHESNUT. *Zoological Club of the University of Chicago:* WILLIAM MORTON WHEELER. *The New York Academy of Sciences: Subsection of Anthropology and Psychology:* LIVINGSTON FARRAND. *The St. Louis Academy of Sciences:* WILLIAM TRELEASE 774

New Books.....776

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ON THE DISTRIBUTION OF MARINE MAMMALS.**

I. INTRODUCTORY REMARKS.

MOST of the recent writers on Geographical Distribution have confined their attention to terrestrial mammals, or, at any rate, have but casually alluded to the marine groups of that class. On the present occasion I wish to call your attention to some of the principal facts connected with the distribution, over the world's surface, of the marine, or aquatic, members of the class of mammals.

Aquatic mammals, which pass their lives entirely, or, for the greater part, in the water are, of course, subject to very different laws of distribution from those of the terrestrial forms. As regards aquatic mammals, land is, of course, an impassible barrier to their extension, and, subject to restrictions in certain cases, water offers them a free passage. Just the opposite is the case with the terrestrial mammals, to which, in most cases, land offers a free pas-

* Read before the Zoological Society of London on March 16th.

sage, while seas and rivers restrain the extension of their ranges.

The groups of aquatic mammals that are represented on the earth's surface at the present time are three in number, viz.: (1) the suborder of the Carnivora, containing the Seals and their allies, generally called the Pinnipedia, which are semi-aquatic; (2) the Sirenia, which are mainly aquatic, and (3) the Cetacea, which never leave the water, and are wholly aquatic. We will consider briefly the principal representatives of these three groups, following nearly the arrangement of them employed in Flower and Lydekker's 'Mammals living and extinct.'

II. DISTRIBUTION OF PINNIPEDS.

The Pinnipeds, which I will take first, comprise three distinct families—the Otariidæ, the Trichechidæ, and the Phocidæ. Beginning with the *Otariidæ*, or Eared Seals, commonly known as Sea-lions and Sea-bears, we find the greater number of the species confined to the South Polar Ocean, where they pass most of their time at sea, but, as is well known, resort to the land at certain seasons for breeding purposes. In the Atlantic Ocean, so far as I know, the Eared Seals have never been ascertained to occur further north than the estuary of the La Plata on the American coast and the vicinity of the Cape on the African coast. But in the Pacific, on the contrary, three distinct species of *Otaria* are found all over the Arctic portion of that ocean, and there are well founded traditions of Eared Seals having been formerly met with in the Galapagos, while they still occur on the coast of Peru and Chili. I think, therefore, we may assume that *Otaria* was originally an Anarctic form, but has traveled northwards along the west American coast and is now firmly established in the North Pacific. In a parallel way in the class of birds, the Albatrosses (*Diomedea*), which are essentially a group of the Antarctic Seas, are represented by three distinct species in the North Pacific.

The second family of the marine Carnivora, on the other hand, the Walruses (*Trichechidæ*), are entirely Arctic in their distribution; one species (*Trichechus rosmarus*) being peculiar to the North Atlantic, while a second nearly allied species (*T. obesus*) takes its place in the Northern Pacific.

The third family of Pinnipeds is more numerous and varied, both in genera and species, than the two preceding and has a more extended range. The Seals, *Phocidæ*, embracing about nine different generic forms, are most numerous in the Arctic and Antarctic seas, but are also feebly represented in some intermediate localities. Beginning with the North Atlantic, we find several species of *Phoca* inhabiting various parts of this area, and the Gray Seal (*Halichœrus*) and the Bladder-Seal (*Cystophora*) exclusively confined to it. In the North Pacific all the four true Seals belong to the genus *Phoca*, and three of them are identical with the North Atlantic species, but when we descend as far south as the Gulf of California on the American coast we meet with a species of Sea-elephant (*Macrorhinus*) which, like *Otaria*, has no doubt penetrated up here thus far from its ancestral abode in the Antarctic Ocean.

Returning to the central Atlantic we find two species of seals inhabiting these waters, both belonging to the same genus *Monachus*. One of these (*M. albiventer*) inhabits the Mediterranean and the adjoining coasts of the Atlantic, while the other (*M. tropicalis*) is in these days restricted to some of the smaller and less known islands of the West Indies.

The *Phocidæ* of the Antarctic Ocean all belong to genera distinct from the Arctic forms and more nearly allied to *Monachus*, the seal of the mid-Atlantic. They are of

four species belonging to as many genera: *Ogmorhinus*, *Lobodon*, *Leptonychotes* and *Ommatophoca*. Besides these the sea-elephant of the whalers (*Macrorhinus*) is essentially an Antarctic form, though now nearly extinct there, after long persecution by man. But, as already noted, it extends, or has in former days extended, far up the west coast of America, and is still occasionally found on Santa Barbara Island, on the coast of California.

III. DISTRIBUTION OF SIRENIANS.

Only two forms of Sirenians are at the present time existing on the earth's surface —the Manatee (*Manatus*) and Dugong (*Halicore*)—each representing a distinct family of the Order. The Manatee is an inhabitant of the coasts and estuaries of both sides of the middle Atlantic Ocean—one species (*Manatus senegalensis*) occurring on the African shores, and another (*M. americanus*) on the South American coast and in the Antilles. A third species (*M. inunguis*), so far as we know at present, is found only in fresh water high up the Amazons.

The Dugong (*Halicore*) is distributed from East Africa, along the shores of the Indian Ocean and its islands, to North Australia. Three species of this genus have been established—*Halicore tabernaculi* from the Red Sea, *H. dugong* from the Indian Ocean, and *H. australis* from Australia; but it is doubtful how far these forms are actually distinguishable.

Besides *Manatus* and *Halicore*, a third quite distinct form of Sirenian was formerly an inhabitant of the North Pacific. This was Steller's Sea-cow (*Rhytina stelleri*), by far the largest animal of the group, which was exterminated by human agency about 1768. Fortunately recent researches in Bering's Island have been successful in supplying specimens of its skeleton for our principal museums, and Steller, its discoverer, left to posterity a good account of its habits and anatomy.

IV. DISTRIBUTION OF CETACEANS.

Adopting the recognized division of the Cetaceans into two Suborders, Mystacoceti and Odontoceti, according as to whether their mouths are furnished with baleen ('whale-bone') or teeth, we will first consider the True or Whale-bone Whales, which consist of a single family, Balænidæ, usually divided into five genera: *Balæna*, *Neobalæna*, *Rhachianectes*, *Megaptera* and *Balænoptera*. Of these, *Balæna*, *Megaptera* and *Balænoptera* are almost cosmopolitan—species of them, whether distinct or not is at present more or less uncertain, being met with in nearly every part of the ocean. But *Rhachianectes* has, as yet, been ascertained to occur only in the Northern Pacific, and *Neobalæna* in the South Polar Ocean, so that we have in these cases two well-marked local types to deal with.

The Toothed Wales (Odontoceti) are more diversified than the preceding group, and are usually held to embrace at least four existing families, besides several extinct forms. The first family, containing the Physeteridæ, or Sperm-Whales, consists of at least six genera (*Physeter*, *Cogia*, *Hyperoodon*, *Ziphius*, *Mesoplodon* and *Berardius*). *Physeter* and *Cogia* are inhabitants of the whole oceanic area between the tropics, extending in certain localities some way beyond them. *Hyperoodon* is confined to the North Atlantic. *Ziphius* has an extensive range, and has been found in nearly every part of the ocean. *Mesoplodon* is also widely distributed, but is apparently more abundant in the Southern Hemisphere. *Berardius*, however, so far as we know at present, is restricted to the South Polar Ocean.

The Third family of Toothed Whales contains only the *Platanistidæ*, or fresh-water Dolphins, which although, in some cases at the present day entirely fluviatile, must

necessarily have all descended from what were originally oceanic forms. The three known genera are *Platanista* of the Ganges and Indus, *Inia* of the river Amazon, and *Pontoporia* of the river La Plata; the last form making a connecting link between the two preceding genera and the marine Dolphins.

The fourth family of Toothed Whales, containing the Dolphins, *Delphinidæ*, is very numerous in species and embraces at least fifteen or sixteen genera. But in spite of the efforts of Mr. True, who has recently given us an excellent summary of our present knowledge of them,* both the genera and species of *Delphinidæ* are still so imperfectly understood that I cannot say much about their geographical distribution. Most of the forms appear to be very widely distributed, but it may be said generally that Dolphins are most abundant in the intertropical seas and less plentiful both to the north and south of them.

There are, however, two forms that are exclusively inhabitants of the North Atlantic. These are the very remarkable Narwhal (*Monodon*), in which the male is furnished with a single enormous horn-like tusk, and the Beluga, or White Whale (*Delphinapterus*), closely allied to the Narwhal in many points of its general structure. These may be looked upon as quite isolated forms characteristic of the Arctic portion of the Atlantic, but not known in the Pacific.

V. DIVISION OF THE MARINE AREA OF THE GLOBE INTO SEA-REGIONS.

From what has been already said, it will be evident that although many of the Marine Mammals have a wide distribution, others are very definitely localized; and a study of the latter will, I think, enable us to divide the oceanic portion of the globe into six Sea-regions, corresponding to a certain extent with the six Land-regions into which I proposed to separate the terrestrial portion of the globe in 1874, and which were subsequently adopted by Mr. Wallace in his standard work on the Geographical Distribution of Animals. I propose to call these Sea-regions:

(1) The *North-Atlantic Sea-region* or *Arctatlantis* (ἄρκτος and ἀτλαντίς = the daughter of Atlas), consisting of the northern portion of the Atlantic down to about 40° N. lat.

(2) The *Mid-Atlantic Sea-region* or *Mesatlantis* (μέσος and ἀτλαντίς), consisting of the middle portion of the Atlantic down to about the Tropic of Capricorn.

(3) The *Indian Sea-region* or *Indopelagia* (ἰνδὸς and πέλαγος), containing the Indian Ocean down to about the same degree of S. lat., and extending from the coast of Africa on the west to Australia and the great Oriental islands on the east.

(4) The *North Pacific Sea-region* or *Arctirenia* (ἄρκτος and εἰρήνη=pax), containing the northern portion of the Pacific Ocean down to about the Tropic of Cancer.

(5) The *Mid-Pacific Sea-region* or *Mesirenia* (μέσος and εἰρήνη) containing the inter-tropical portion of the Pacific Ocean; and finally

(6) The *Southern Sea-region* or *Notopelagia* (νότος and πέλαγος), containing the whole of the South Polar Ocean all around the globe south of the above mentioned limits.

We will now proceed to consider shortly the characteristic Mammals of these six Sea-regions.

VI. THE NORTH ATLANTIC SEA-REGION, OR ARCTATLANTIS.

Amongst the Pinnipeds, two well-marked generic forms, the Gray Seal (*Halichœrus*) and the Bladder-Seal (*Cystophora*) are exclusively confined to Arctatlantis. The True Seals (*Phoca*) and the Walrus (*Trichechus*) are found in this region and in Arctirenia; and of the former genus three species (*P.*

*See 'A Review of the family Delphinidæ,' by Frederick W. True: Bull. U. S. Nat. Mus. No. 36; Washington, U. S., 1889.

vitulini, *P. grœnlandica*, and *P. barbata*) are actually common to both these Sea-regions, while the Walruses (*Trichechus rosmarus* and *T. obesus*) of the two Sea-regions are perhaps somewhat doubtfully distinguishable. It may be easily understood how this has come to pass, because the Seals and Walrus may in the course of time, during unusually mild summers, have extended themselves along the north coast of the American continent into the Northern Pacific. But Arctirenia, as we shall presently show, is markedly distinguishable from Arctatlantis, by the presence of Eared Seals (*Otaria*), which is utterly unknown in the whole of the Atlantic area. *Otaria* is, in fact, as regards Arctatlantis what I have called, on previous occasions (see P. Z. S. 1882, p. 311), a 'lipotype' of Arctatlantis, but what I now propose to designate a 'lipomorph.'*

The Sirenians are entirely absent from the North Atlantic and constitute another lipomorph of that area.

Coming to the Whales, we find the *Mystacoceti* well represented in the North Atlantic by *Balœna*, *Megaptera* and *Bolœnoptera*, but of these the two latter are almost universally distributed over the ocean, and *Balœna* recurs again in the North Pacific as well as in more southern latitudes, so that there is no genus of Whalebone Whales peculiar to Arctatlantis, although the great *Balœna mysticetus* has never been found elsewhere.

Proceeding to the *Odontoceti*, the case is different. Amongst the *Physeteridæ*, *Hyperoodon* is confined to Arctatlantis and, as already explained, two very well-marked types of the *Delphinidæ*, *Delphinapterus* and *Monodon*, are likewise exclusively denizens of the North Atlantic ocean. Arctatlantis, therefore, may be said to be well characterized by the possession of at least five genera of Marine Mammals not found elsewhere, viz., *Halichœrus*, *Cystophora*, *Hyperoodon*, *Delphinapterus*, and *Monodon*.

* On former occasions I have used the term 'lipotype' for a natural group which characterizes a particular locality by its *absence*. It would, however, perhaps be better to change the term to 'lipomorph,' because the type and its compounds have been generally employed in reference to the particular specimens of a species upon which original descriptions are based (*cf.* Thomas, P. Z. S. 1893, p. 241). In the same way a natural group which characterizes a particular country may be called a 'topomorph' (*τόπος locus* and *μορφή forma*). Thus in Africa *Giraffa* and *Phacochœrus* would be 'topomorphs,' and *Cervus* and *Ursus* would be 'lipomorphs.'

VII. THE MIDDLE ATLANTIC SEA-REGION, OR MESATLANTIS.

Mesatlantis has certainly not so many forms of Marine Mammals confined to its area as Arctatlantis, but there seem to be good grounds for its separation As we descend towards the tropics the true Seals (*Phocinæ*), which are constituted to live in colder water, gradually fall off in number, and in Mesatlantis are no longer met with. But in their place we find the genus *Monachus* or Monk Seal restricted to Mesatlantis, one species (*M. albiventer*) occurring in the Mediterranean and on the North African coast, and a second (*M. tropicalis*) being found in the West Indies. Mesatlantis is likewise the true home of the well-marked Sirenian genus *Manatus*, one species of which (*M. americanus*) frequents the coast of America and another (*M. senegalensis*) that of Africa.

As regards the Cetaceans we are not able to say that Mesatlantus, although well-furnished with many generic types of this Order, has one peculiar to it. We must, therefore, rest content with assigning two genera of Marine Mammals, *Monochus* and *Manatus*, as characteristic forms or topomorphs of the Sea-Mammal life of Mesatlantis.

VIII. THE INDIAN SEA-REGION, OR INDOPELAGIA.

The Marine Carnivora, so far as we know, are entirely foreign to Indopelagia, but the

Sirenians are well represented by the Dugong (*Halicore*), which pervades all its northern coasts from North Australia to India and the Red Sea and down the African coast to Lamu*. Whether the species of *Halicore* found at different points within this area are the same or different is still a matter of discussion, but there can be no doubt that *Halicore* is an exclusive inhabitant of Indopelagia. As regards the Whales of Indopelagia, we know that *Physeter*, *Cogia* and *Ziphius*, and numerous forms of *Delphinidæ*, occur there, but I am not aware of any Cetacean that is entirely restricted to this Sea-region.

IX. THE NORTH PACIFIC SEA-REGION, OR ARCTIRENIA.

As was pointed out when speaking of Arctatlantis, Arctirenia has one genus of *Phocidæ* (*Phoca*) in common with the North Atlantic, and three of the species of this genus appear to be actually identical in these two Sea-regions, whilst a fourth *Phoca* (*P. fasciata*) is only found in the North Pacific. The Walrus (*Trichechus*) is again a form of Marine Mammals, common to both the great northern Sea-regions. But the feature of Pinnipedian life that absolutely distinguishes Arctirenia from Arctatlantis is the presence in the former of three (if not four) well-marked species of the Eared Seals (*Otariidæ*), which are absolutely unknown in the vast extent of the Atlantic down at least to 30° S. lat.

Arctirenia has unfortunately lost its Sirenian, Steller's Sea-Cow (*Rhytina stelleri*), the largest and finest modern representative of this formerly prevalent group, which since the days of the Pleistocene, has greatly diminished in numbers, but I think we may still treat *Rhytina* as one of the characteristic forms of the Arctirenian Sea-region. The North Pacific is also even at the present day the sole possessor of a remarkable genus of Whalebone Wales which combines the long head and elongate form of *Balænoptera* with the smooth skin of the throat and absence of the dorsal fin of *Balæna*.* This is the Gray Whale, *Rhachianectes glaucus* of Cope, which, in these days, is confined to the North Pacific, and does not range farther south than the 20th parallel in that ocean. At the same time it should be stated that indications have been discovered that a nearly allied form existed in the Atlantic in previous geological ages, though this is by no means certain. Besides *Rhachianectes* *Balæna*, *Megaptera* and *Balænoptera* are all represented in the North Pacific, and also many species of *Delphinidæ*, of which little is at present known. But *Rhytina* and *Rhachianectes* are the only genera of Marine Mammals absolutely confined to Arctirenia.

X. THE MIDDLE PACIFIC SEA-REGION, OR MESIRENIA.

The Eared Seals, *Otaria*, must have necessarily passed through Mesirenia in their passage from south to north, though the only record of their recent presence in the central part of the Pacific is, so far as I know, the report that they were formerly found in the Galapagos. It should be stated, however, that Tschudi records the occurrence of two species of *Otaria* on the islands of the coast of Peru, and that in 1802 Humboldt met with an Eared Seal on the island of San Lorenzo, in the Bay of Callao, which is only some 12° south of the Equator.

Like *Otaria*, the Sea-elephant (*Macrorhinus*) has apparently in former ages travelled up the South American shores and established itself as far north on the coast of California as about 34° N. lat. The California Sea-elephant has been discriminated by Gill as a distinct species (*Macrorhinus angustirostris*), but its differences from

* A fine specimen of the Dugong from Lamu (on the east coast of Africa, lat. 2° 50′ S.), obtained by Mr. J. C. Haggard in 1885, is in the British Museum.

* Flower and Lydekker, Mammals, p. 241.

the southern form (*M. leoninus*) seem to be but trifling.

As regards the Cetaceans of Mesirenia, our information is at present very imperfect, and I have little to say except that species of *Megaptera*, *Balænoptera*, *Physeter*, *Cogia* and *Ziphius* certainly occur there, besides many representatives of the widely spread *Delphinidæ*.

XI. THE SOUTHERN POLAR SEA-REGION, OR NOTOPELAGIA.

The wide ocean which surrounds the Southern Pole on every side, and extends up to 40° S. lat., seems to present, as regards its marine mammals, a nearly homogeneous fauna, which we will now briefly consider. In the first place it contains representatives of four genera of true *Phocidæ*—*Ognorhinus*, *Lobodon*, *Leptonychotes*,* and *Ommatophoca*, which are peculiar to the southern seas, and are quite distinct from all their northern representatives in the Arctic Ocean. The Sea-elephant, *Macrorhinus*, is also a denizen of Notopelagia, though, as we have already seen, it has wandered north along the South American coast far into Mesirenia.

Like *Macrorhinus*, *Otaria* also, containing the group of Eared Seals, appears to have been an Antarctic group, and the greater number of its species, although now-a-days very much reduced in numbers, are still found in the Southern Ocean. But the *Otariæ* have travelled still further north than *Macrorhinus*, and three, if not four, species, as already stated, are in these days well established inhabitants of Arctirenia.

The Sirenians are absent from Notopelagia, but Cetaceans of every kind are abundant. Besides one or more representatives of the true Whale-bone Whale (*Balæna*), Notopelagia has a smaller representative of the group (*Neobalæna*) entirely restricted to its area. It has also representatives of *Megaptera* and *Balænoptera*, though it is doubtful how far they are even specifically distinct from some of their northern representatives.

Among the Toothed Whales (*Odontoceti*) we find a large Ziphioid form, *Berardius*, restricted to the Notopelagian area, while *Ziphius* and *Mesoplodon* also occur there. The Dolphins (*Delphinidæ*) are likewise numerous and present some distinct species, but not, so far as our present knowledge extends, any generic forms that do not occur elsewhere.

But Notopelagia is sufficiently distinguished from all the five more northern Sea-regions by possessing four genera of Seals and two of Cetaceans entirely restricted to its area.

XII. CONCLUSIONS.

It has, therefore, I think, been shown that for the Geography of Marine Mammals the Ocean may be most conveniently divided into six Sea-regions, which are as follows:

I. *Regio Arctatlantica*, characterized by its Seals (*Phocinæ*), of which two genera, *Halichærus* and *Cystophora*, are peculiar, whilst *Phoca* is common to it and Arctirenica; by the absence of Sirenians; and by the possession of three peculiar genera of Cetaceans (*Hyperoodon*, *Delphinapterus* and *Monodon*).

II. *Regio Mesatlantica*, sole possessor of the Monk-seal, *Monachus*, amongst the Pinnipeds, and of the Sirenian genus *Manatus*.

III. *Regio Indopelagica*, characterized by the presence of the Sirenian *Halicore* and by the absence of Pinnipeds.

IV. *Regio Arctirenica*, with *Phoca*, like the Regio Arctatlantica, but having *Otaria* also; the home of the (now extinct) Sirenian *Rhytina* and of the endemic Cetacean *Rhachianectes*.

* This generic term, established by Gill in 1872, seems to take precedence of *Pœcilophoca*, proposed by Flower and Lydekker for the same type (*L. weddelli*) in 1891. *Cf.* Allen, North American Pinnipeds, p. 418.

V. *Regio Mesirenica*, without true Seals (*Phocinæ*), but having *Otaria* and *Macrorhinus* from the south; no Sirenian known.

VI. *Regio Notopolagica*, characterized by four endemic genera of *Phocidæ*, and by the presence of many *Otariæ*; without Sirenians, but with two endemic forms of Cetaceans (*Neobalæna* and *Berardius*).

In conclusion, I will call attention to some of the more remarkable points in the general distribution of the marine Mammals, and to their apparent significance.

In the first place it is evident that the Pacific has much more in common with the Notopelagian region than the Atlantic. *Otaria* and *Macrorhinus*, quite unknown in the Atlantic, extend themselves to the northern extremity of the Pacific, the former pervading that ocean up to Behring's Straits, and the latter reaching to the Californian coast. It follows that in former ages there must have been some barrier in the Atlantic which did not exist in the Pacific to stop their progress northwards. The only barrier I can imagine that would have effected this must have been a land uniting South America and Africa, across which they could not travel. Adopting this hypothesis, we have, at the same time, an explanation of the presence of the Manatee on both the American and African coasts. The Manatee could hardly live to cross the Atlantic. It is only found close to the coast, where it browses on sea-weeds and other vegetable food in shallow water. How did it travel from America to Africa (or *vice versa*), unless there were a continuous shore-line between them? The same may be said of the Monk Seal (*Monachus*), of which one species lives in the Mediterranean and on the African coast and Islands, and another in the West Indies. We can hardly believe that these creatures could easily traverse the whole Atlantic. The hypothesis of a former barrier of land between Africa and America, which we know is supported by other facts of distribution,* would alone explain the difficulty.

On the other hand, in the Pacific we find no such break between the north and south. The aquatic Mammals of Notopelagia have evidently had free access to the whole Pacific for a long period and have well availed themselves of this facility.

Again, while the great Southern Ocean exhibits a considerable uniformity of marine Mammalian life, we see the Northern waters divided into two distinctly recognizable Regions by the interposed masses of land. All these facts, with the one exception of the supposed Atlantic Barrier, would tend in favor of the now generally accepted doctrine that the principal masses of land and water are not of modern origin, but have existed mainly in their present shapes throughout all ages.

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FORMER EXTENSION OF CORNELL GLACIER NEAR THE SOUTHERN END OF MELVILLE BAY.†

The initial effort of Professor Tarr's paper is to controvert the opinions recently expressed by Chamberlin and Salisbury respecting the former extension of the general glaciation of Greenland, their view being that the coast was not universally and profoundly overwhelmed by the inland ice. The observations of Professor Tarr had a range in latitude of about 5° 30′, those of Mr. Chamberlin about 17° 15′, and those of Professor Salisbury about 12°. The joint observations of Chamberlin and Salisbury covered 18° 30′, the range of their landings being about 13° 40′. These landings embraced thirteen different localities, counting the numerous landings on the border of Inglefield Gulf as one. This statement has

* *Cf.* Wallace, Geogr. Distrib. Vol. I., p. 156.

† Bull. Geol. Soc. Amer., Vol. 8, pp. 251–268, Plates XXV.–XXIX., March, 1897.

FIG. 1. "THE DEVIL'S THUMB. Elevation 2,650 feet; glaciated surface in foreground; rugged, angular topography in background on left. Transported pebbles obtained on crest of the Devil's Thumb. Photograph by J. O. Martin." [Author's legend.]

its occasion in the too insistent implication of the author of the paper under review that the observations whose validity he questions were limited to those made chiefly from a passing vessel. Of the latitude covered by the observations of Chamberlin and Salisbury about 8° 30′ lay south of the tract seen by Professor Tarr, and about 4° 30′ lay to the north of it. If the total distribution of observations be divided into three parts, 8° 30′, 5° 30′ and 4° 30′, in order from south to north, Professor Tarr's observations fall within the middle division and cover less than one-third of the whole.

It appears, therefore, that the testimony of 5° 30′ is being urged to set right the testimony of 18° 30′ in a matter of *general* conclusions. In such an attempt it would seem altogether imperative that an author urging conclusions from the minor fraction should have ascertained, with scrupulous care, whether his own observations within that fraction confirmed or contradicted the *coincident* part of those made upon the much wider tract. Singularly enough, this vital prerequisite is neglected, although an explicit statement covering this common territory had been made by Professor Salisbury (*Journal of Geology*, Vol. III., 1895, pp. 876–877).

What are the respective conclusions relative to this common tract? Professor Tarr insists upon general glaciation. Salisbury and Chamberlin believe in general glaciation with the exception of some high peaks and lee faces. Of the exceptions named by them none was visited by Professor Tarr. There is, therefore, no direct observational conflict. More than this, no observations of the one party demonstrate glaciation where the other thought it absent. The grounds for an issue are, therefore, rather tenuous. The two sets of observations are in reality rather confirmatory than conflicting. The issue has arisen from an attempt to adjudicate the whole coast by a fraction which happens to be intermediate in type, having been neither strongly subjugated by glaciation nor left conspicuously intact.

Fig. 2. Dalrymple Island—Type of unglaciated topography. (Bull. Geol. Soc. Am., Vol. VI., pp. 219; also Jour. Geol., Vol. II., 1894, p. 661.)

The author recognizes that the conclusions of Chamberlin and Salisbury are based upon evidence of two kinds: "one, the presence of a driftless area in the Inglefield Gulf region, announced by Professor Chamberlin; and a second, the angular topography of the Greenland coast, described by both." The first evidence, although vital to a *general* conclusion, is passed without discussion, because it was not seen by the author. He remarks, however, in a footnote that he "cannot let this opportunity pass without raising the query whether the topography in the neighborhood of the Greenland driftless area is not such that an area of this sort would naturally be expected. Was not the movement of the ice outward and the main stream down the Inglefield Gulf? And is not the driftless area located in the place where the high Red Cliff peninsula would naturally have clogged the ice and hence prevented its action of erosion and notable transportation?" The driftless area is a part of the same ancient peneplain as the summit of the Red Cliff peninsula (*Journal of Geology*, p. 205–6, Vol. III., 1895). It lies on the *east side of Red Cliff peninsula* (see map, p. 668, Vol. II., *Jour. Geol.*). It lies *between it and the great ice cap*. It is separated from the peninsula by the valley of Bowdoin bay, about two miles wide and 2,000 feet deep. How an isolated part of a peneplain can protect from glaciation another part of the same plain lying between it and the source of the glacial motion and several miles distant is not easily understood. The suggestion apparently sprang from the same lack of circumspection that gave birth to the main issue without adequate grounds.

The evidence drawn from topography is the main subject of discussion in the initial portion of the paper. The essential point urged in the paper and reiterated in subsequent discussion is that angularity of topography is compatible with general glaciation, and that general observations on topographic contours have little or no value in deciding the prevalence of glaciation. The most important illustrative evidence in support of this is a photographic view of 'The Devil's Thumb.' The photograph is here reproduced (Pl. 26, Vol. VIII., 1886, *Bull. Geol. Soc. Am.*). (Fig. 1.) Nothing has recently so astonished the present writer or his colleague as the presentation of this photograph as an illustration of the *absence* of topographic signs of glaciation. It is a marvel to us how any glacialist could fail to read from these coutours—even from the summit contours— just that degree of glaciation which was found by the more rigorous lines of study. It is true that the lee side is angular, but this does not in any essential way confuse or obscure the dominant expression, which is that of moderate glaciation. That geologists may see how different are the contours that led Professor Salisbury and the writer to infer absence of glaciation in certain other regions, there is here reproduced the photograph of Dalrymple Island which was used as an illustration of the asperities of a typical angular topography (*Jour. of Geol.*, Vol. II., p. 661). (Fig. 2.) It must be evident to the critical observer that the two topographies belong to distinct types. The contours of Dalrymple Island clearly show the absence of any glacial softening. The contours of the so-called Devil's Thumb and of the adjacent region clearly portray a moderate measure of glacial softening. The normal asperities of a non-glacial arctic topography are gone. This topographic expression seems to the reviewer to be such as to be read with ease and accuracy even at a distance, especially after the general habit of the region has been determined by more rigorous lines of evidence. The photograph does not sustain the author in calling the topography angular in an unqualified sense; nor does it sustain him in insisting that it is imprac-

ticable for observers to detect such signs of glaciation.

An additional source of confusion is introduced by naming the promonotory of the photograph 'The Devil's Thumb.' It is stated in a foot-note that "This is the Devil's Thumb as given on the Danish and British Admiralty charts. The real Devil's Thumb of the Arctic explorers is some forty or fifty miles to the north of this" (p. 254). The true Devil's Thumb is, however, sketched on the British Admiralty chart. The sketch as there given is herewith photographically reproduced (Fig. 3). It will

FIG. 3. The Devil's Thumb, as given on the British Admiralty Chart.

be seen that it does not bear even a remote resemblance to the promontory illustrated in the paper. It is to be assumed without question that the latter stands at the location designated on the charts as The Devil's Thumb, but this location is obviously an error. It does not seem to us that it justifies the transfer of the name Devil's Thumb to a new promontory to which the name has no fitness. It is especially unfortunate to introduce a second Devil's Thumb in this connection, because the true Devil's Thumb, by reason of its slenderness and angularity, has a significant bearing on the question of glacial extension, and together with Melville Monument a similar pinnacle somewhat further north has been so cited. Misapprehension has already arisen on account of this double use of the name. The slenderness and angularity of the Devil's Thumb are exaggerated in the sketch of the Admiralty chart—about as much as such objects are usually exaggerated by the impressions of the average observer. With some discount for this it gives a fair idea of this singular landmark.

If the true Devil's Thumb, Dalrymple Rock, and similar instances of angularity and asperity are taken as one type; if the contours illustrated by the paper under review be taken as a second type; if the contours of the Carey Islands (*Journal of Geology*, Vol. II., p. 662) be taken as a third type, and if the plainer topography north of Godhaab be taken as a fourth type, something of the degrees and gradations of topographical modification which the coast belt of Greenland suffered at the hands of glaciation will be indicated.

The view of the author that the peaks would remain more angular than the valleys seems perfectly valid so long as the conditions are *limited to the border of the ice cap*. Near the border the thickness of the ice in the valleys is much greater than upon the hills. The main flowage is through the valleys, and subjugation of the heights is relatively slight. On the other hand, this reasoning entirely falls to the ground when applied to profound glacial submersion, such as is implied by an advance of the 100 or 200 miles necessary to reach the heart of Baffin's Bay. Such an advance means a depth of at least 5,000 feet of ice on the peaks. In this case the difference between the depth on the heights and in the valleys is relatively much less, and three well established principles combine to emphasize the erosion of the peaks: (1) the upper portion of the ice moves faster than the lower; (2) erosion is correlated with rapidity of motion by some high power of the rate; (3) peaks yield to erosion more than embossments of the valley, because (a) the surface exposed to action is relatively greater, and (b) the attachment, and hence the resistance, of the exposed parts is relatively less. The erosion, therefore, proceeds on the crests with a facility superior to that in the

valleys by the measure of some multiplier much greater than unity. When valleys are irregular the basal retardation is still further increased and the movement of the ice is correspondingly transferred to the upper horizons. The irregularities of the coast of the region in question give this fact special application. The interpretation of the author is, therefore, quite consistent with a *limited* extension of the ice border, but quite inconsistent with profound extension. The whole of the phenomena described in the paper are precisely concordant with moderate extension. They are as precisely discordant with great extension.

The remainder of the paper consists of a description of the Cornell glacier, of the evidences and amount of former invasion, of the recent advance and retreat of the ice, and of the evidences of present retreat of the Cornell glacier. This portion embraces much valuable data, unless it is vitiated, as it probably is not, by the lack of care which marks the controversial part. It is accompanied by excellent photographs, all of which, as the writer would interpret them, show evidences of greater or less glacial modification of contour.

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SUGGESTIONS FOR A NEW METHOD OF DISCRIMINATING BETWEEN SPECIES AND SUBSPECIES.

ACCORDING to present usage the rule which determines whether a particular animal or plant shall stand in our books as a species or subspecies may be stated as follows: *Forms known to intergrade, no matter how different, must be treated as subspecies and bear trinomial names; forms not known to intergrade, no matter how closely related, must be treated as full species and bear binomial names.* This principle was first distinctly formulated in the Code of Nomenclature of the American Ornithologists' Union, published in 1886. In the remarks that follow, the authors of the Code state: "The kind or quality, not the degree or quantity, of difference of one organism from another determines its fitness to be named trinomially rather than binomially. A difference, however little, that is reasonably constant, and therefore 'specific' in a proper sense, may be fully signalized by the binomial method. Another difference, however great in its extreme manifestation, that is found to lessen and disappear when specimens from large geographical areas or from contiguous faunal regions are compared is, therefore, not 'specific,' and, therefore, is to be provided for by some other method than that which formally recognizes 'species' as the ultimate factors in zoological classification. In a word, *intergradation* is the touchstone of trinomialism."

Eleven years have now elapsed since the publication af the A. O. U. Code of Nomenclature, in which the above canon and statement were first published. During this period the plan advocated has been very thoroughly tested, not only by ornithologists, but by systematists in many other departments of zoology, and also in botany. The time has come, therefore, when it should be possible to examine its practical workings, with a view to ascertaining whether or not the system is satisfactory.

In practice it has been found that only in a small percentage of cases does an author have at his command a sufficiently large series of specimens, from a sufficient number of well-selected localities, to enable him to say positively that related forms do or do not intergrade. The result of this obvious embarrassment is that authors usually exercise their individual judgment as to the *probable* existence or non-existence of intergradation, thus introducing the personal equation it was hoped to avoid. The natural result is a degree of inconsistency in the use of trinomials which has formed the subject

of much criticism, and which, under existing rules, it seems impossible to avoid. But its inconsistencies are not the only objection to the present system. From the nature of the case, increase in knowledge as to the interrelations of forms often shows that those treated as full species really intergrade, and that closely related forms supposed to intergrade really remain distinct, necessitating corresponding changes from a binomial to a trinomial, and *vice versa*. Changes of this kind may be found in the A. O. U. Check-List of North American Birds by comparing the editions thus far issued.

It will be many years, even in America, before it will be possible to say that certain forms do or do not intergrade, and until that time a fixed nomenclature will be impossible.

In view of the objections to the present system—incurable inconsistency, inevitable changes with increase of knowledge, and consequent delay in attaining a fixed nomenclature—and also in view of what to me seems the logic of the case, it would appear desirable to modify the system in the interest of consistency, stability and common sense.

In systematic zoology and botany a knowledge of the *degree of difference* between related forms is infinitely more important than a knowledge of whether or not the intermediate links connecting such forms happen to be living or extinct. It would seem, therefore, since it is is impossible for our nomenclature to tell everything we wish to know about a species, that it would serve a more useful purpose if the terms species and subspecies were so used as to indicate degree of difference, rather than the author's opinion as to the existence or non-existence of intergrades. It may be argued that 'degree of difference' is an elastic term, incapable of measurement and subject to the same personal equation that besets the present system. While this is to a certain extent true—since authors rarely see objects through the same spectacles—it is also true that individual opinion as to whether or not an observed degree of difference is worthy of specific recognition would vary within much narrower bounds than in the alternative case of hypothetical intergradation; and, further, that the change in nomenclature incident to the discovery of new facts, inevitable under the old system, would be entirely done away with.

This leads to what is, after all, the most practical consideration in connection with the proposal to be governed by *degree of differentiation rather than intergradation* in our choice of binomial and trinomial nomenclature, namely, the quantity of difference it is desirable to accept as a measure of specific distinctness. Some authors, like Mr. Lydekker in England, and Mr. Roosevelt in this country, would have us limit the number of species to types of groups, many of which are commonly regarded by naturalists as of subgeneric or even generic weight. Among the larger mammals their species are nearly always used in a superspecific sense. Thus they would have one large wolf, one small wolf, one black bear, one large brown bear, and so on, urging that the recognition of a number of related species is inconvenient, interfering with the clear and easy comprehension of the different groups. Of course this is true, but since the function of the naturalist is neither to create nor destroy species, but to recognize, describe and learn as much as he can about those which nature has established, a difficulty arises in carrying out their views of classification. It is one thing to say—without taking the trouble to find out the characters that distinguish a batch of species—what one thinks ought to be done for the easier comprehension of the science; a very different thing to arrange the animals themselves in accordance with the species which actually exist.

A good deal, of course, depends on the point of view. Mr. Lydekker as a paleontologist and compiler of excellent general works on natural history, and Mr. Roosevelt as a hunter and writer of the best accounts we have ever had of the habits of our larger mammals, find it inconvenient and annoying to be confronted by a large number of species. Still, if we examine the writings of these authors closely it becomes evident that they usually accept without complaint such species as have been currently recognized by their predecessors. This is only human nature, for are we not always more ready to challenge the announcement of new facts than to suspect those with which we have been long familiar?

In my judgment, forms which differ only slightly should rank as subspecies even if known not to intergrade, while forms which differ in definite, constant and easily recognized characters should rank as species even if known to intergrade.

In a recent article in SCIENCE, Mr. Roosevelt protests against the use of the word species where "it has entirely different weights in different cases," and cites examples of what he considers its proper use. But he forgets a host of cases in which admittedly distinct species are not separated by any such gaps as those he mentions. Mr. Roosevelt, in addition to being a good deal of a mammalogist, is something of an ornithologist, and has made contributions of value to ornithological literature. He knows, therefore, that in the eastern United States we have two species of falcons belonging to the genus *Falco*, the Sparrow Hawk and the Duck Hawk, and two species of woodpeckers belonging to the genus *Melanerpes*, the Red-headed Woodpecker and the Red-bellied Woodpecker, in both of which cases the species are separated by the kind of gaps he likes. He knows also that we have two species of thrushes, the Olive-back and Alice's, and two species of small flycatchers, Traill's and the Least, in both of which cases the species are so much alike that a trained eye is necessary to tell them apart. What will he have us do with these birds? Shall we unite the two thrushes and the two flycatchers? If not, how can he reconcile his theory to the enormous difference in weight of characters that distinguish the species of hawks and woodpeckers, contrasted with those that distinguish the thrushes and flycatches? The real difficulty is that in nature some existing species are closely related, while others are widely separated. Still, suppose for the sake of argument that we do attempt to carry out Mr. Roosevelt's suggestion to lessen the number of species by uniting some of those that are more or less closely related, and suppose we select for this purpose two groups of mammals—the bears and coyotes—against whose species he has developed such a violent aversion. If in case of the bears we try to get rid of either the Grizzly (*Ursus horribilis*), the Barren-ground (*U. richardsoni*), the Yakutat bear (*U. dalli*), or the huge Alaska Peninsula bear (*U. middendorffi*), and in the case of the coyotes we aim to abolish any one of half a dozen species, as the northeastern *Canis latrans*, the California *C. ochropus*, the Rio Grande *C. microdon* or the Mexican *C. cagottis*, we are at once confronted by the same difficulties that would beset Mr. Roosevelt were he to undertake to unite under a smaller number of specific names such birds as the Hermit, Wood, Olive-back, Bicknell's and Wilson's thrushes, or the Warbling, Red-eyed, White-eyed, Hutton's and Philadelphia vireos. These difficulties are of several kinds and involve the solution of such questions as: (1) How many and what species shall be selected as the favored ones with which the others shall be merged? (2) Which of the species to be

distributed among the chosen ones shall go to this and which to that? (3) When we have made what seems to be the best conglomeration practicable with the material at hand, how are we to frame descriptions that will cover such incongruous assemblages and distinguish them from one another? And after all (4) why should we try to unite different species under common names? It is well to remember that the book of nature is not always easy to read, and that in the great majority of cases we know nothing of the ancestry of individual species.

A prolific source of error respecting the interrelations of allied forms is the common assumption that such forms are necessarily derived from one another. In numerous instances this is not the case, their origin dating back to a common ancestor now extinct. Thus a species which in Pleistocene times had a transcontinental distribution may have given off in remote parts of its range several lines of descendants, each of which has since spread over so large an area that the resulting forms, originally widely separated, have now come to inhabit contiguous areas and as a consequence are assumed to intergrade.

Possibly the skepticism of Mr. Lydekker and Mr. Roosevelt as to the validity of the new species of mammals recently described is a result of unconsciously overlooking the wide difference in the present status of the sciences of ornithology and mammalogy. Relatively, ornithology is a finished science, while mammalogy is yet in its infancy. Birds have been studied by scores of able naturalists; mammals by comparatively few individuals. The disproportion in available material is even greater, for museums containing many thousands of bird skins rarely have more than a few hundred mammals. Until recently our museums have made no effort to secure series of mammals from extreme points in their geographic ranges, so that specimens might be placed side by side for direct comparison in order to ascertain positively—instead of assuming theoretically—what the differences really are. Even to-day no museum in the world possesses anything like an adequate series of any of our larger mammalia. In the few cases in which specimens of supposed single species have been brought together from widely separated areas it has generally been discovered that two or more species had been confounded under a single name.

In America the science of mammalogy took a long sleep after the pioneer work of Audubon, Bachman and Baird, which ended with the publication of their great works in 1854 and 1857. From this time until about ten years ago little advance was made. Then an active interest in the subject sprang up and scientific collecting really began. It is probably safe to say that during the past decade more mammals have been collected in North America alone than were previously contained in all the museums of the world. Furthermore, these specimens are not only of infinitely better quality than the old, but are accompanied by full data, uniform field measurements and perfect skulls. As a result, it is now becoming possible, for the first time in the history of the science, to bring together for actual comparison series of specimens in the different groups covering the greater part of the range of these groups in an entire continent. Is it surprising that the study of such material should result in the discovery of many new species? As a matter of fact, during the last ten years the number of species known in North America has been considerably more than doubled, and several entirely new genera have been found.

In criticising a recent paper of mine on the coyotes, Mr. Roosevelt says: "The important point is the essential likeness of all the coyotes one to the other, and their

essential difference from the big wolves with which they are associated, and which are themselves essentially like the big wolves of Europe and north Asia; and it seems to me that these facts can best be brought out by including the coyote and the wolf in one genus and treating each as a species. Then the geographical and other varieties may or may not be treated as worthy of subspecific rank according to the exigencies of the particular case."

The above remarks are based on a total misapprehension of the facts in the case and remind one of the judge who gave his decision first and tried the case afterward. As a matter of fact, two assumptions are made by Mr. Roosevelt which are widely at variance with the facts. The first is the assumed 'essential likeness of all the coyotes one to the other;' the second, the assumed 'essential difference [of the coyotes] from the big wolves.' I can show Mr. Roosevelt a series of skulls of wolves from the United States in which the great gaps are not between the big wolves and coyotes, but between two species of big wolves and two of coyotes. Thus, there is an enormous gap between the large northern coyote (*C. latrans*) and the small *C. microdon* from the lower Rio Grande, and another great gap between the big red wolf of Arizona and the big gray wolf of Wyoming. On the other hand, no such gap exists between the northern coyote and the big red wolf of Arizona, the skulls and molar teeth of these species resembling one another surprisingly. Mr. Roosevelt's third assumption, the assumed essential likeness of our big wolves to the big wolves of Europe, may be correct or incorrect according to the parts of Europe and America from which specimens are taken. The southern wolves of the two countries are too unlike to require close comparison, and even in the case of the northern forms the specific distinctness is apparent as soon as the skulls are brought together. Thus, not to mention other differences, the long muzzle and narrow forehead of the wolf of our northern plains offer a sufficient contrast to the short muzzle and broad forehead of the Scandinavian animal.

In my paper on the coyotes eleven forms were recognized, of which seven were named for the first time. All were treated binomially, but it was intimated that *pallidus* and *lestes* would probably be found to intergrade with *latrans*, and that *estor* might intergrade with *mearnsi*, leaving eight as distinct species. It was stated that the available material was insufficient to admit 'of determining which members of each group do and which do not intergrade,' for which reason it was necessary, in obedience to the rule respecting the use of specific and subspecific names given at the beginning of this article, to treat all as species. This was done reluctantly and with the conviction that the rule is illogical and should be changed. If the plan here recommended is adopted we need not care whether intergradation occurs or not, but may bring together as subspecies the closely related forms, and accept as species those more distantly connected.

In conclusion, let me appeal to museums, sportsmen and naturalists to take advantage of every opportunity, before it is too late, to secure and preserve specimens of our larger mammals from remote parts of their ranges. In Europe it is certain that many species have been exterminated through the agency of man, and in this country the process is not only about to be repeated, but has already begun. The familiar story of the vanishing buffalo is only one of many. The largest carnivorous animal of the United States, the giant grizzly of southern California, is on the verge of extinction, and it is doubtful if a museum specimen will ever be obtained. The large wolves have been exterminated over more than half the area they formerly

possessed, and no one knows what forms have disappeared and an unknown form of elk or wapiti which within the memory of our fathers—and of some men still living—inhabited the Alleghany region from North Carolina to the Adirondacks has been wiped off the face of the earth.

C. Hart Merriam.

THE NATIONAL ACADEMY OF SCIENCES.

ON THE VARIATION OF LATITUDE.*

At the autumn meeting of the Academy in 1894 the author had presented the numerical theory of the motion of the pole, synthetically derived from the observations from the beginning of the history of the astronomy of precision up to that time, in its complete development, exactly as it stands to-day. Since then he had been interested to compare it with the various series of observations subsequently published, not only for the purpose of verification and improvement of the numerical values of the various constants, but also to detect any additional characteristics which these later data might make apparent. These additional investigations had individually been neither extensive nor important enough to call for separate publication; since their general result has been merely a satisfactory confirmation of the previous deductions as to the nature of the law of these motions, without furnishing material improvement of the numerical elements. But sufficient material has thus been gradually accumulated to make the present communication of some interest.

The new material to be here utilized consists of the various series of observations by Tallcott's method up to the middle of 1896, so far as published, at the following European stations, named in order of longitude: Kasan, Vienna, Prague, Berlin, Potsdam, Karlsruhe and Strassburg. In America we have Doolittle's series at Bethlehem, which was brought to a close in the summer of 1895. He is now carrying forward a new series at Philadelphia of which we may hope soon to see the results. Of the series at Columbia University, by Rees, Jacoby and Davis, begun in the spring of 1893 and still current, there have come to hand the results for the first fourteen months. It is an extremely fortunate circumstance that a portion of this series, yet unreduced, will bridge the gap in Doolittle's work rendered unavoidable by his removal from Lehigh University to the University of Pennsylvania.

The curves of latitude variation from these various series were then exhibited, and compared with the numerical theory. This comparison shows a fidelity of representation eminently satisfactory, the differences between computation and observation being practically within the range of errors of observation.

A determination of the elements of the ellipse of the annual component of the polar motion was then presented, made from the newer observations, independently of the older ones previously used. The resulting elements are practically identical as to form, size and position of this ellipse. This seems to show that the axis of this elongated vibratory motion is stationary on the earth's surface, along a meridian forty-five degrees east of Greenwich. This negative evidence as to any apsidal motion seems to be of extreme importance in its bearing on the theory of the earth's rotation.

A demonstration was then presented of the fact that since 1890 the circular 428-day motion has been diminishing its radius in conformity to the requirements of the numerical theory derived from the observations between 1825 and 1890.

In addition to the above, a discussion was presented of 645 observations of the Pole Star made with the Pulkowa Vertical

*Abstract of a paper presented by Dr. S. C. Chandler.

circle between 1882 and 1891. This series is especially interesting and important in that it covers an interval during which we have very little other information, of an extensive character, as to the variations of latitude. A comparison of the curves of observation and theory thus provided for this decade exhibited a most striking accordance, and seems to leave no possible doubt that Nyrén's inference, that his observations do not betray evidence of the existence of the annual component of the polar motion, is erroneous and attributable to illogical methods in drawing his conclusions.

THE VARIATION OF LATITUDE AT NEW YORK, AND A DETERMINATION OF THE CONSTANT OF ABERRATION FROM OBSERVATIONS AT THE OBSERVATORY OF COLUMBIA UNIVERSITY.*

THE results given in this paper were obtained from 1,774 observations made between May 6, 1893, and June 20, 1894, with an 8-centimetre Wannschaff zenith telescope. The observations were planned for a determination of the constant of aberration by Küstner's method. Four groups of stars were used, having mean right ascensions approximately, as follows:

Group I	6^h
II	14
III	18
IV	22

Each group contained seven pairs of stars, and covered two hours in right ascension. The groups were observed both morning and evening, whenever the weather permitted. The original plan of observations required four observers, but it was unfortunately necessary to reject altogether the work of one observer. This caused considerable gaps in the series, in addition to those due to unfavorable weather conditions.

Only observations obtained during the period when it was possible to observe both evening and morning groups were used in calculating the latitude results employed for the computation of the constant of aberration. The observations of each group were gathered together into periods of about ten days each, in such a manner that the weighted mean of the dates should be the same for both the evening and morning groups. In this way the mean latitudes from the two groups should differ only on account of the difference between the declination systems of the two groups, and on account of any error in the assumed value of the aberration constant. They cannot differ on account of variation of latitude, provided any such variation is uniform during the short time of ten days. The result for the aberration constant is therefore independent of any assumption as to the law of latitude variations.

The constant of aberration was found to be $20''.457 \pm 0''.013$. The mean latitude of the observing station* was 40° 48′ 27″.195. The table of definitive latitudes for every ten days showed the variation of latitude, which was very small. The probable error of a single latitude was $\pm 0''.16$.

Observations have been continued from the date last given to the present time by Professor Rees and Dr. Davis, and will be kept up for some time longer. Reductions of the later series will be finished soon. A series of observations on the same stars has been made and is now being continued at the Royal Observatory at Capodimonte, Naples, by Professor Em. Fergola and two assistants, Messrs. Contarino and Angelitti.

NOTES OF EXPERIMENTS UPON THE RÖNTGEN RAYS.†

IN most investigations hitherto made for testing the question of the refraction of

* Abstract of a paper presented by Professor John K. Rees, Professor Harold Jacoby and Dr. Herman S. Davis.

* The observing station was at the new site of the University, about four miles north of the present University Observatory.

† Abstract of a paper presented by Professor A. W. Wright.

the rays the refracting body has been in the form of a prism. This involves the inconvenience that the absorption of the rays is so much greater toward the thicker portion of the prism as to cause imperfect or unequal definition in the image of the slit or wire used for the test. This has sometimes given rise to the appearance of a deflection of the rays away from the base of the prism instead of towards it, a negative action, implying a refractive index less than unity.

In the present experiments this was avoided by employing for the refracting bodies thick pieces of glass and Iceland spar with parallel sides, which were inclined at an angle of 45° to the path of the rays. The distances traversed by the rays in the two media were about 10 and 14 mm. respectively. The displacement of the image for ordinary light is about 1.5 mm. for the glass, and for the Iceland spar about 1.0 mm. and 1.8 mm. respectively, for the two images due to double refraction. A small platinum wire, stretched so as to be quite straight, rested upon the upper surfaces of the plates, and the rays from the tube were passed through a narrow slit in a copper plate. The slit was parallel with the wire and at a considerable distance from it. A strong and very clearly defined image of the wire was formed upon the photographic plate, showing no displacement by the glass plate or the Iceland spar, and no trace of widening or duplication by the latter, or, in other words, no perceptible effect of refraction, or double refraction.

Other experiments were described, in which very sharply defined images of fine platinum wires produced by the rays upon a photographic plate showed a faint central band, dark in the negative but light in the positive, corresponding to the familiar bright central band behind an opaque wire in the case of luminous rays. The converse effect of a dark central band in the positive from a narrow slit was also observed, but less distinctly. These results offer some support to the idea of true diffraction and the periodic character of the rays, but the matter must be regarded as somewhat uncertain until secondary maxima and mimima are obtained, which would settle the question of diffraction and permit the definite determination of wave-lengths.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

A MEETING of the Council of the American Association for the Advancement of Science was held at Washington, D. C., on April 12th. Owing to the lamented death of Professor Edward D. Cope, the late President of the Association, Professor Theodore Gill presided as Senior Vice-President. A number of members were elected, and several matters of importance relating to the Detroit meeting were discussed and arranged at this meeting.

Professor Leland O. Howard, of the Department of Agriculture, Washington, D. C., was nominated as Vice-President and Chairman of Section F, to fill the vacancy caused by the death of Professor G. Brown Goode. Professor Howard was requested to prepare an address to be delivered before the Section at the Detroit meeting.

Professor I. C. White, Vice-President and Chairman of Section E, will go to St. Petersburg this summer as one of the delegates to the International Congress of Geologists. He will, however, prepare his Vice-Presidential address to be read before the Section at the Detroit meeting.

On Monday evening, August 9th, at the Detroit meeting, Professor Theodore Gill will deliver a memorial address on the life and work of Professor Cope, at the time and place appointed for the Presidential address, which was to have been given by Professor Cope. In this address Professor Gill will

give an account of the development of vertebrate paleontology, with which Professor Cope was so intimately connected.

Dr. Seth C. Chandler, of Cambridge, was elected Auditor of the Association, to fill the vacancy caused by the death of Dr. B. A. Gould.

The Permanent Secretary read the letters received from the British Association for the Advancement of Science in which it was stated that the General Committee of the British Association had voted to make the officers of the Detroit meeting of the A. A. A. S. honorary members of the B. A. A. S. for the Toronto Meeting, and to receive all fellows and members of the American Association as members of the British Associatian for the Toronto meeting by the payment of the regular annual assessment. It was voted that the Permanent Secretary should acknowledge the courtesy of the British Association and at the same time should express the hope that members of the British Association would be present at the Detroit meeting, calling attention to the provision in the constitution of the American Association relating to members of foreign associations.

Considerable discussion followed as to the proper method of extending courtesies to such members of the British Association as might take part in the Detroit meeting. It was voted that members of the British Association at Detroit should be invited to register as members of the several sections of the American Association, and that special attention should be paid by the officers of the respective sections to all foreigners thus registering.

The Permanent Secretary was instructed to arrange for the delivery of the Vice-Presidential addresses at the Detroit meeting in the afternoon as at former meetings.

F. W. PUTNAM,
Permanent Secretary, A. A. A. S.

CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS.

THE fourth triennial session of the Congress was held at Washington on May 4th, 5th and 6th. The meeting was well attended, as it deserved to be, the proceedings of the Congress as a whole and of the separate societies being interesting and profitable. Washington, especially in the spring, is the best possible place for such meetings, and this was recognized by deciding to hold the triennial meetings hereafter in that city. The only drawback is the lack of an adequate auditorium, which may be provided in the interval.

The proceedings of the Congress, as a whole, included several joint discussions. On Wednesday afternoon the Association of American Physicians, the American Physiological Society and the American Pediatric Society, united in discussing 'Internal Secretions considered in their Physiological, Pathological and Clinical Aspects.' The other subjects taken into consideration in the general sessions were 'The Gouty and Rheumatic Diatheses and their Relation to Diseases of the Eye,' Otology in its Relations to General Medicine,' 'Deformities of the Hip-Joint, especially Congenital Dislocations,' and 'The Classification of Acute General Peritonitis: The Prognosis and Treatment of the Different Varieties.'

The address by the President, Professor William H. Welch, on Thursday evening, was entitled, 'Compensatory and Protective Pathological Processes,' and was an admirable presentation of the subject, equally interesting to the practitioner and to the man of science concerned with the study of adaptations and evolution. The attendance at the meeting was large, although it and the subsequent reception were unfortunately simultaneous with a lecture by Sir Archibald Geikie and a reception to him in the rooms of the Geological Survey. Other ar-

rangements for the entertainment and social intercourse of members were a banquet on Tuesday evening at the Arlington and a 'Smoker' given by the Cosmos Club on Thursday evening.

On Wednesday afternoon a statue of the late eminent surgeon, Samuel D. Gross, was unveiled on the Smithsonian grounds near the Army Medical Museum. The statue was presented to the United States Government in a speech by Dr. C. N. Mastin, and was received by Surgeon-General George M. Sternberg. An address was made by Professor W. W. Keen, the successor of Gross at the Jefferson Medical College. It is to be hoped that many statues of men who have contributed to the advancement of science may ultimately find their place in the grounds of the Smithsonian Institution.

Reports of the proceedings of the American Physiological Society and of the Association of American Anatomists will be published in this journal. The papers presented before the various medical societies were so numerous that it is not possible to present a report of them, even though many of the contributions were not merely of interest to the medical specialist, but were also valuable contributions to science. The societies taking part in the Congress, their presidents and the numbers of papers offered before each, were as follows:

The American Otological Society,
Dr. Arthur Mathewson, Brooklyn, N. Y. 6 papers.
The American Neurological Association,
Dr. M. Allen Starr, New York City. 27 papers.
The American Gynecological Society,
Dr. James R. Chadwick, Boston, Mass. 21 papers.
The American Dermatological Association,
Dr. James C. White, Boston, Mass. 26 papers.
The American Laryngological Association,
Dr. Charles H. Knight, New York City. 18 papers.
The American Surgical Association,
Dr. John Collins Warren, Boston, Mass. 21 papers, including six subjects, followed by special discussion.
The American Climatological Association,
Dr. E. Fletcher Ingalls, Chicago, Ills. 26 papers.
The Association of American Physicians,
Dr. J M. DaCosta, Philadelphia, Pa. 36 papers.
The American Association of Genito-Urinary Surgeons,
Dr. Francis S. Watson, Boston, Mass. 20 papers.
The American Orthopedic Association,
Dr. Samuel Ketch, New York City. 45 papers.
The American Physiological Society,
Dr. Russell H. Chittenden, New Haven, Conn. 22 papers.
The Association of American Anatomists,
Dr. Frank Baker, Washington, D. C. 10 papers.
The American Pediatric Society,
Dr. Samuel S. Adams, Washington, D. C. 33 papers.
The American Ophthalmological Society,
Dr. George C. Harlan, Philadelphia, Pa. 38 papers.

ZOOLOGICAL NOTES.

COLOR CHANGE IN THE PLUMAGE OF BIRDS UNACCOMPANIED BY MOULT.

Not long ago Science noticed two papers, one by Dr. J. A. Allen and one by Mr. F. M. Chapman, in which the possibility of any change of color taking place in a feather after it was fully developed was emphatically denied. Now Dr. Arthur E. Chadbourne comes forward in the *Auk* for April, 1897, with facts which seem to make it evident that this alleged impossibility does take place. The author kept a pet Bobolink from January until the breeding plumage was complete, and writes as follows: "The bird always seemed well and strong, and the *color change was* NOT *accompanied by any increase in feather loss, i. e.*, not greater than during the winter, and often for several days in succession there were no cast-off feathers at all to be found. The total during the three weeks that the change was in progress was *thirteen*—namely, two broken rectrices and eleven contour feathers. It is hardly possible that any stray specimens were unnoticed, for even had they fallen outside of the cage they would have been found in the room, and a wire netting protected the window. 'Pin-feathers' could hardly have been overlooked, if present; for I often held the bird in my hand and

carefully examined it, blowing back the plumage until the skin could be seen. It is also safe to say, doubtless, that the cast-off feathers were not eaten by the bird itself. Hence it follows that unless the previous plumage was made up of only two tail and eleven body feathers, both of the former on the same side—which was certainly not the case—*my Bobolink was unquestionably an instance of color-change in the plumage without moult.*"

Dr. Chadbourne had already presented evidence tending towards the same end in *the Auk* for October, 1896, and January, 1897, wherein he discusses change of color in the Screech Owl, *Megascops asio.*

In *The Ibis* for October, 1896, Mr. John G. Millais also discusses the problem of color-change without moult, describing and figuring feathers from the Eared Grebe, *Colymbus auritus*, and Sanderling, *Calidris arenaria*, showing the great probability of such change taking place. The word *probability* is used advisedly, for Mr. Millais figures feathers in different stages from different birds, and while this evidence may be very strong it can not in the nature of things be so conclusive as change of color in the plumage of a bird kept under observation day after day.

In spite of all that has been written, the moulting and change of color in birds is comparatively little known, and it remains a fine field of research for the investigator who is willing to spend his time in the patient and careful collection of facts.

F. A. L.

NOTES ON INORGANIC CHEMISTRY.

FOR some time past there has been a tendency on the part of an increasing number of chemists to attack the problems of inorganic chemistry, profiting by the light which the study of organic chemistry has thrown upon the carbon and nitrogen atoms. This is an encouraging tendency from the standpoint of theoretical chemistry, for while the devotion of by far the largest proportion of chemists, for several decades down to the present time, to organic chemistry has widened vastly our knowledge of organic compounds and the carbon atom, yet the study of all other atoms is even more necessary for the theory of chemistry. Relatively very few inorganic compounds have been studied and some of our most familiar reactions are illy understood. So far from the inorganic field having been long ago worked out and exhausted, it is here that the chemistry of the future will find its most prolific harvest. Yet the field is far harder to till and less productive of immediate results.

THE *Berichte* of the German Chemical Society might almost seem to be devoted to organic chemistry, so large is the preponderance, yet we find that the inorganic field is not wholly neglected. In the last number Muthmann and Seitter contribute an investigation of the sulfid of nitrogen, which is in part a development of earlier work of Demarçay. When nitrogen sulfid N_4S_4 is treated with chlorin a theachlorid $N_4S_4Cl_4$ is formed, as shown by Andreocci. When sulfur chlorid is used, a compound of the formula N_3S_4Cl is obtained, and from this a series of derivatives, including the bromid, iodid, nitrate and thiocyanate. There thus appears to be a comparatively stable univalent group, N_3S_4, which the authors believe to have a ring formula analogous to that of benzine.

IN the same *Berichte*, Pawlewski, of Lemberg, gives a careful study of the physical properties of sulfuryl chloride, SO_2Cl_2, and some of its chemical reactions. Professor Söderbaum, of Gothenburg, in the same number describes a reaction between acetylene and cupric salts. The cuprous acetylid has been long known, but that acetylene gives a precipitate with cupric salts has

apparently been overlooked. The compound formed seems to have a very complex formula, being represented by $C_{17}Cu_8H_4O_3$. It is more explosive than the corresponding cuprous compound and, unlike it, on treatment with dilute acid yields very little acetylene. It gives, on the contrary, a humus-like substance of a formula of about $C_{12}H_4O_3$, which resembles both humic acid and the so-called graphite hydrate obtained from the graphite of cast iron. It would seem to be an unique case of the condensation of acetylene, at ordinary temperature under the influence of a copper salt, to a compound of high molecular complexity.

J. L. H.

ASTROPHYSICAL NOTES.

In No. 367 of the Proceedings of the Royal Society is a note by Professor Oliver Lodge, read on February 11th, in which he calls attention to the notable discovery by Professor P. Zeeman, of Amsterdam, that lines in the spectrum of a flame may be broadened when a magnetic field is concentrated upon the flame.

Zeeman's paper appears in the *Philosophical Magazine* for March (Vol. 43, pp. 226–239). He alludes to the fact that similar experiments were the last researches of Faraday, in 1862. With the relatively slight dispersion then available, however, the effects could not have been observed.

Sodium and lithium were used by Zeeman, and the broadening effects were observed in both the emission and absorption spectra, which were obtained from a powerful concave grating.

The experiment was also tried on the band spectrum of absorbing iodine vapor, with negative results, which, however, confirmed the accuracy of the experiments with sodium. The widening of the sodium lines to both sides amounted to about $\frac{1}{10}$ of the distance between D_1 and D_2 (that is, to about 0.15 tenth-meters). As the intensity of the magnetic field was about 10^4 c.g.s. units, there would be a positive and negative magnetic change of $\frac{1}{10000}$ of the period.

The theory of the motion of ions or electrons, whose vibrations are those of light, is discussed according to the views of Professor Lorentz, who pointed out to Zeeman that if the theory was true the edges of the widened lines ought to be circularly polarized in the direction along the lines of magnetic force, and plane polarized in directions normal to the lines of force. This was clearly shown by experiment to be the case, and it has been confirmed by Lodge, who also readily obtained the broadening effect in the sodium flame.

These researches are decidedly suggestive, and have an important astrophysical as well as physical application. The view is held by many that strong magnetic forces occur in the sun (and hence by analogy in the stars). Thus a new cause may perhaps be assigned for the wide range and variations in the breadth and intensity of spectral lines of celestial bodies.

E. B. F.

SCIENTIFIC NOTES AND NEWS.

LEGISLATION ON THE FOREST RESERVATIONS.

The Senate, on May 6th, adopted Senator Pettegrew's amendment to the Sunday Civil Appropriation Bill, suspending President Cleveland's order of February 22d, setting aside some 20,000,000 acres of timber lands in the Northwest as forest reservations. The N. Y. *Evening Post* calls this action 'monstrous,' and it seems to be generally misunderstood. The Senators from the States concerned favor forest reservations, but President Cleveland's order, with the laudable purpose of adequately celebrating Washington's Birthday and securing to his administration the credit of this important movement, seems to have been premature. The letter from the Secretary of the Interior to the President of the National Academy of Sciences requested an official expression of the Academy upon the following points:

1. Is it desirable and practicable to preserve from fire and to maintain permanently as forested lands those portions of the public domain now bearing wood growth for the supply of timber?

2. How far does the influence of forest upon climate, soil and water conditions make desirable a policy of forest conservation in regions where the public domain is principally situated?

3. What specific legislation should be enacted to remedy the evils now confessedly existing?

It came within the province of the committee to recommend the setting aside of additional forestry reservations, but its primary object was to suggest an intelligent policy for the preservation of the reserves previously made. The Academy was especially asked for an opinion on the legislation recommended by the American Forestry Association and by the American Association for the Advancement of Science, in the hope that the weight of the Academy's influence would induce Congress to enact the needed legislation. Recommendations to this effect will doubtless be in the report now prepared by the committee of the Academy, and will guide the President and the Secretary of the Interior in the administration of the reserves in accordance with the powers given them by Senator Pettigrew's amendment.

THE BEQUESTS OF THE LATE PROFESSOR COPE.

THE will of Edward D. Cope, signed October 1, 1895, in accord with the guiding principles of his life, leaves, after making ample provision for his family, his collections for the benefit of science. His scientific books, his osteological collection, and his collection of fresh-water mollusca are given to the School of Biology of the University of Pennsylvania, and his collection of minerals to the University. Duplicates of the collection of fresh-water mollusca are to go to the Cincinnati Society of Natural History and to the American Museum of Natural History. The collections preserved as wet preparations and the skins of animals are given to the Philadelphia Academy of Natural Sciences. The paleological collections are divided into three parts: *First.* The North American collection. *Second.* The South American, *i. e.*, the Pampean collection which was purchased of the Buenos Ayrean exhibitors at the Paris Exposition of 1878, and small collections from the West Indies and Mexico. *Third.* European collections chiefly from the Neocene of Alber of France. It is directed that these collections be sold, and after the payment of private bequests, including $2,500 to each of his assistants, Mr. Jacob Geismar and Miss Anna M. Brown, that the balance, estimated at $40,000, be given to the Academy of Natural Sciences at Philadelphia, as an endowment for a professorship or curatorship of vertebrate paleontology. The incumbent must be an original investigator elected by the Council of the Academy and approved by the National Academy of Sciences, $400 of the income of this endowment to be used for the procurement, either by collection or purchase, of vertebrate fossils. The executors of the will are Mr. John B. Garrett and Professor Henry F. Osborn.

GENERAL.

A MEMORIAL meeting in honor of the late Professor Sylvester was held under the auspices of the Johns Hopkins University on May 1st. Addresses were made by Dr. Fabian Franklin and others.

THE Flower Astronomical Observatory of the University of Pennsylvania was dedicated on the afternoon of May 12th. An address was made by Professor Simon Newcomb.

PRINCE LUIGI with a large party will shortly arrive in this country, with a view to making explorations in Alaska and ascending to the summit of Mt. St. Elias. Professor I. C. Russell has made thorough explorations of the mountain, attaining a height of 12,000 feet, but the summit, some 18,000 feet in height, has never been reached.

THE Literary and Philosophical Society of Sheffield proposes to have painted for the Society a picture of Dr. H. C. Sorley in celebration of the fiftieth anniversary of the beginning of his scientific work.

THE degree of LL.D. has been conferred by the University of Edinburgh on Professor James Dewar and Dr. John Willie.

THE Royal Geographical Society has elected the following as honorary corresponding members: Professor G. Della Vedova, Baron Toll and Captain Otto Irminger.

Dr. Nansen's proposed lecture before the Geographical Society at Rome has been abandoned because the Society was unable to pay the terms demanded.

The Board of Estimate and Apportionment of New York City have authorized the issue of bonds to the amount of $500,000, the money to be used for the erection of a further wing for the American Museum of Natural History. Plans for the wing prepared by the architects, Messrs. Kodeberg and See, were submitted and approved.

The class of 1897 of Yale University has presented to the Peabody Museum a meteorite, weighing 65 lbs., which was found three years since in Kansas.

A proposition in the Massachusetts House of Representatives to amend the bill appropriating $150,000 for the work of exterminating the gypsy moth, by making the amount $200,000, was voted down, but the bill itself was ordered to a third reading.

It is reported that the authorities of the elevated railways of New York City have examined Mr. Keely's motor with a view to its introduction. It is probable that the nature of motor was not made clear to them and that it will not be used in New York. Scientifically inclined people are not likely to believe that Mr. Keely's motor can make something out of nothing, but this will not be the opinion of those who have invested money in the scheme.

At the monthly general meeting of the Zoological Society of London, held on April 22d, it was reported that the additions to the Society's menagerie during the month of March were 152 in number. Special notice was directed to three examples of the Indian pygmy goose (*Nettopus Coromandelianus*), presented by Mr. Frank Finn. It was stated that many attempts had previously been made to introduce this bird into Europe, but without success, and that these were the first specimens which had reached the Society's gardens alive.

Another great Auk's egg has been sold at auction in London—this time to Mr. G. T. Middlebrook for 280 guineas.

The appearance of two new serials is noted in *Natural Science: The Aeronautical Journal*, published by the resuscitated Aeronautical Society, and *East Asia*, a quarterly, which will include the natural history, etc., of the region.

Dr. C. Du Bois-Reymond, son of the late Emil Du Bois-Reymond, expects to edit, from the notes of students, the courses of lectures given by Du Bois-Reymond, at the University of Berlin, on the Results of Modern Science and Physical Anthropology.

It gives us regret to announce the death of Martin L. Linell, Aid in the Department of Insets of the U. S. National Museum for the past nine years. Mr. Linell was 47 years of age, a Swede by birth and a former student in the University at Lund. He came to America in 1879, and was at first Curator of the Brooklyn Entomological Society, accepting the position in the National Museum in 1888. He was one of the most learned coleopterists in the country, and his high scientific attainments, as well as his thorough acquaintance with the great collection of insects at Washington, will render it very difficult to fill his place.

The *American Naturalist* for May contains a short appreciation of the late Professor Cope, by Dr. Persifor Frazer, who takes *pro tem.* Cope's place as senior managing editor of the journal, and an article on Cope by Professor J. S. Kingsley, who for many years was associated with Cope in the editorship of the journal. The number also contains six portraits of Cope. Four of these are from photographs taken respectively in 1879, 1884, 1887 and 1892. These show an evident gain in force of expression, which appears not to be unusual with men of great achievement. The frontispiece of the number is from an oil painting by Mr. George W. Pettit, in the possession of the American Philosophical Society, and a second full-page plate is from a bust by Mr. Eugène Costello.

The opening article of the May number of the *American Journal of Science* is an admirable memoir of Hubert Anson Newton, by Professor J. Willard Gibbs. The frontispiece of the number is a portrait of Professor Newton in his library, taken by a member of his family in the spring of 1894. The appended bibliography contains 69 titles.

FROM a note in the current number of the *American Journal of Science* we take the following facts regarding the late Matthew Carey Lea, who died on the 15th of March. He was born in 1823, and was the eldest son of Isaac Lea, the publisher, well known as a geologist and a mineralogist, but especially as a conchologist in connection with his investigations on the genus *Unio*. His early associations giving him a special interest in scientific matters, he entered the laboratory of Professor James C. Booth and there acquired great proficiency in chemistry. To this science he devoted his life, his chemical researches being numerous and important. He was elected to membership in the National Academy of Sciences in 1892, and the list of his more important papers then published contained fifty-four titles. These investigations for the most part related to the chemistry of photography, and especially to the action of light and other forms of energy upon silver salts. He described photo-bromide and photo-iodide of silver, and in 1887 published a paper on the 'Identity of the photo-salts of silver with the material of the latent photographic image.' His most remarkable discovery, made in 1889, was that silver is capable of existing in three allotropic states.

ON the catalogues of Muscineæ by Mitten, in Godman's Natural History of the Azores, which recognized 47 species from the archipelago, and the recent collections of Trelease, Brown, Carreiro, Machado, Blanchy, Richard and Minelle, M. Cardot in the last report of the Missouri Botanical Garden bases a catalogue of 88 Azorean species and 14 varieties or forms, of which 9 species and 3 varieties are considered as new to science. He also describes one new species and indicates one other as probably undescribed, from a small collection of 19 species made on Madeira last year by Trelease. Eleven plates illustrate, in habit and detail, the novelties.

A LETTER from Professor Th. Tschernychew to Dr. Persifor Frazer in reference to the approaching International Geological Congress is translated and published in the current number of the *American Naturalist*. It states "that from this time on the number of persons who have inscribed themselves is so great—nearly 700—that it will be absolutely impossible to enable them all to take part in the excursions." It is not clear from this whether those already registered may be excluded from the excursion or whether this applies only to new applicants, but those who are attracted to the Congress by these excursions will do well to make enquiry.

THE issue of SCIENCE for February 12th contained an article by Professor A. B. Macallum on the arrangements for the Toronto meeting of the British Association. We are now able to give the preliminary daily programme, which is as follows:

Wednesday, August 18th. Reception Room open, 8 a. m. to 6 p. m.; Meeting of Council at 10 a. m.; Meeting of General Committee at 3 p. m ; Address of the President, Sir John Evans, in Massey Hall, at 8 p. m.

Thursday, August 19th. Sectional Meetings in most cases, 10 a. m. to 3 p. m.; Garden Party, 3.30 to 6 p. m ; Conversazione in the Legislative Buildings, 8.30 to 11.30 p. m.

Friday, August 20th. Sectional Meetings in most cases, 11 a. m. to 3 p. m.; Garden Party, 3.30 to 6 p. m.; Lecture by Professor W. C. Roberts-Austen, C.B., F.R.S., in Massey Hall at 8.30 p. m.

Saturday August 21st. Sectional Meetings, 10 a. m. to 1 p. m.; Excursion of Members of Section G. (Mechanical Science) to Niagara, 9 a. m. to 6 p. m.; Excursions to Hamilton and neighborhood, Niagara Falls and Muskoka Lake Region, returning on Monday morning. Lecture to Workingmen. Lecture and subject to be announced.

Monday, August 23d. Sectional Meetings in most cases, 10 a. m. to 4 p. m; Excursion of Members of Section C (Geology) to Scarboro' Heights, 1 to 6 p. m.; Garden Parties; Lecture by Professor J. Milne, F.R.S., on Earthquakes, in Massey Hall, at 8:30 p. m.

Tuesday, August 24th. Sectional Meetings in most cases, 10 a. m. to 3 p. m.; Garden Party at Trinity College, 4 to 6 p. m.; Conversazione in the University Building, 8:30 to 11:30 p. m.

Wednesday, August 25th. Some Sectional Meetings, 10 a. m. to 1 p. m.; Concluding General Meeting, 2:30 p. m.; Garden Parties, 3:30 to 6 p. m.; Banquet in honor of Lord Kelvin, Lord Lister and Sir John Evans, 8 p. m.

Thursday, August 26th. Excursions to Niagara Peninsula, Thousand Islands, Ottawa, Montreal, Upper Lakes and to Manitoba and British Columbia. (See Excursion Guide.)

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. E. B. COXE has given Lehigh University $20,000 as a fund in memory of her husband, Eckley B. Coxe, the income of which is to be used for the support of poor and deserving students.

COLORADO COLLEGE has been given $10,000 by an anonymous donor to be used for a building for women students.

THE Massachusetts Institute of Technology receives, by the will of the late William Tappen, Jr., Milton, Mass., $10,000 to be used for deserving students, and is further made the residuary legatee of the estate.

THE will of the late Rev. Caleb Bradley, of Dedham, Mass., gives $2,000 to Tufts College and $2,000 to Gales College.

DR. E. FISCHER has been promoted to a full professorship of botany in the University at Berne, and has been made Director of the Botanical Gardens. Dr. Gustav Jäger, docent in the University of Vienna, has been appointed to an assistant professorship of theoretical physics, and Dr. Friedrich Gräfe, docent in the Polytechnic Institute at Darmstadt, to an assistant professorship of mathematics.

MR. A. FRANCIS DIXON has been appointed professor of anatomy in the University College of South Wales. It appears that the method of election was for three selected candidates to appear before the Council, one to be chosen by that body.

DISCUSSION AND CORRESPONDENCE.

ON SUPPOSED EFFECTS OF STRAIN IN TELESCOPIC OBJECTIVES.

TO THE EDITOR OF SCIENCE: In your issue of April 23d (page 656) I notice a criticism by Professor E. S. Holden, Director of the Lick Observatory, which seems to me to call for a word of comment. Professor Holden is inclined to discredit the observations of Mercury and Venus made by Mr. Percival Lowell and his assistants at Flagstaff, principally for the reason that they have not as yet been 'fully confirmed by other observers with other telescopes.' The markings seen by Mr. Lowell he attributes to a supposed strain on the glass, induced by an overtight condition of the adjusting screws or of the objective in the cell.

Now it happens that I personally superintended the adjustment of the Lowell objective in the cell at Flagstaff before the observations in question were made, and I am satisfied that the screws holding the glass in place were *barely turned home with the fingers*. I desire to express it as my belief, founded on long experience as a practical optician, that strain in the glass is incapable of producing the effect of markings on a planetary disc. It is obvious that the same class of strain which exists in the Lowell must be present also in the Lick objective, since both are mounted precisely alike in their cells on triangular bearings; and if such effects were produced in the 24-inch glass as Professor Holden imagines they would be much more apparent in the 36-inch.

Having worked both of these objectives myself, and expended as much artistic ability on the one as on the other, there can be no impropriety in my saying that the performance of the Lowell glass is equal to that of the Lick or any of our large telescopes.

ALVAN G. CLARK.

CAMBRIDGEPORT, MASS.,
May 1, 1897.

THE LOESS FORMATION OF THE MISSISSIPPI REGION.

TO THE EDITOR OF SCIENCE: In reply to Professor J. E. Todd's letter in your issue of April 30th I wish to offer the following remarks:

A complete and satisfactory answer of the questions presented by Professor Todd would require a thorough discussion of the Loess formation; but the necessarily limited nature of this communication, and my own imperfect knowledge of the formation in its entirety, will admit only of my touching briefly upon a few points.

There is, in portions of the upper Mississippi region, particularly in that part of it with which I am best acquainted — northwestern Illinois, a silt deposit which is spread out over the very uneven uplands as an originally nearly uniform sheet, and whose relation to belts of comparatively thick typical loess along the

main streams is similar to that between the gray loamy clay and the 'loess' of Missouri. The upland deposit is similar in composition to the typical loess of the valleys, except that it contains a large constituent of fine clay particles which partially bind the rounded silt grains. This deposit of unusually argillaceous loess, besides mantling the upland ridges, descends the slopes of the valleys and is present over the thick terrace-like deposits of true loess. They are separated by a smoothly undulating but quite sharp line. This line is present throughout northwestern Illinois and in Iowa at Dubuque. Without discussing the significance of this line, I will call attention to the fact that Chamberlin and Salisbury, in making the study of the loess of the 'Driftless Area,' recognized the distinction between the silt deposits along the main streams and on the uplands remote from the main water-courses, particularly on the east side of the Mississippi river; and in reference to their origin they say, on pages 306–7 of the 6th Annual Report of the U. S. Geological Survey, "the loess-depositing waters were neither true lakes nor true rivers, but assumed an intermediate fluvio-lacustrine character, possessing sufficient onward flow to prevent the deposition of a large proportion of the clayey constituents of the silt they bore. * * * The loess probably represents the debatable ground between the two" (a lake and a river). "The coarser stratified portion along the immediate valleys of the great streams seems clearly on the fluvial side of the line, while the broad, loam-like mantle apparently lies on the other side." It is this comparatively thin but uniform mantle of argillaceous loess or loam, on the uplands and in the valleys, for whose origin I claim a purely lacustrine or possible semi-marine character, largely because, while clearly water-laid, it passes within one-half mile and less from the top to the base of hills 100 and even 200 or more feet in height. It mantles a region having a range in altitude of 600 or more feet.

With special reference to the question of the mode of formation of the gray loamy clay of Missouri, which I regard as a portion of the Loess formation, as also does Professor Todd, I wish to make the following statements, which, I believe, can easily be demonstrated to be facts:

The drift sheet of northern Missouri was not laid down on a perfectly level plain, but on an undulating upland, dissected by valleys of which the Missouri and Mississippi were examples. The Missouri valley, at least from Boonville onward, is preglacial inage, and it is hardly necessary for me to add that the Mississippi valley along the entire east border of the State is so also. These valleys do not now have much drift because it has been removed from them by subsequent erosion.

The line of Professor Todd's supposed 'barrier' or ridge from the Osage-Gasconade divide to Pike county, Illinois, being traversed by two important preglacial valleys—the Mississippi and Missouri—loses its effectiveness to account for the difference in altitude of the loess plains of northern Missouri and southern Illinois.

The gray loamy clay or 'upland loess' of northern Missouri was laid down on an undulating plain, some portions of which have a decided slope. The 'fluvial' theory of its origin, which supposes that the area upon which it was being formed was dry during a large part of the year, and, therefore, that it was deposited somewhat like the alluvial silts of the Mississippi delta at the highest flood stages, is opposed by the inequalities, when considered over broad areas, of the surface of the sheet of loess or loam. Rivers do not wander about except on plains which have an even and very slight slope. In order to uniformly sheet with water-laid silt even a very slightly hilly region, a lake-like body of water is required. That which covered northern Missouri at the time the 'upland loess' was deposited may not have exceeded 50 or 100 feet in average depth, and may not have covered the entire loess region at one time, but its nature was decidedly different than that of a river.

The failure to find beach ridges is far from being positive evidence of the absence at any former time of the shore line of a great lake, or even of the sea. For instance, the ocean waters in advancing over Florida to form the Columbia sands which mantle the northern portion of the peninsula, and later in withdrawing

from the same area, formed no distinct beach ridges; at least none have been observed by the writer. In Citrus and neighboring counties the marine Columbia sands seem to be composed of three members—a lower or red member (formed while the shore line was advancing inland), a middle or yellow member (formed mainly during the culminating period of the submergence), and an upper or white member (formed while the shore line was retreating). These rest upon an undulating land surface, rising in a distance of about eight miles, from sea level at Crystal River, to an altitude of about 180 feet A. T., near Lecanto, and again descending to nearly sea level in the Withlacoochee valley. No prominent beach ridges were formed *because the shore line did not remain at one level on the slope of the land a sufficient length of time.* This is only one of a number of similar cases which might be mentioned where the sea advanced upon and retreated from a sloping land surface without forming beach ridges.

In regard to the other objections against the lacustrine origin of the Missouri 'upland loess,' presented by Professor Todd, namely, that it is absent from certain areas in the eastern part of the State near the junction of the Mississippi and Missouri rivers and at a low level, I wish to suggest that it may have been there present originally as a very thin sheet which has since almost disappeared because of erosion. Past experience has taught me that when the loamy deposit which constitutes the 'upland loess' is very thin and patchy and approaches closely in composition and appearance to the residuary clays it is, by many geologists, scarcely recognized as a portion of the Loess formation. This suggestion is justified by the fact that I have observed in the region traversed by the St. L. and S. F. railroad, between Cuba and Pacific City, a loamy clay, usually free from pebbles, apparently separated from the residuary clay by a sharp line, and overspreading the surface of a hilly country like the 'upland loess' in northwestern Illinois. If this is a portion of the Loess formation it indicates that the lake or sea waters rose against the northeastern corner of the Ozark uplift to an altitude of 1,000 or more feet, or rather I should say that the land went down to that amount below these waters. The superficial silts of this region ought to be investigated. O. H. Hershey.

Freeport, Ill.

Scientific Literature.

Birds of the Galapagos Archipelago. By Robert Ridgway. Proc. U. S. National Museum, Vol. XIX., pp. 459–670, 2 pls. Cover title-page dated 1896, but not published till March, 1897.

It was in the Galapagos Islands that Darwin, during the memorable 'Voyage of the Beagle' in 1835, made the original observations which led him to discover and formulate the great principle of evolution—to the elucidation of which the remainder of his life was so successfully devoted—and it was the birds of these islands which first drew his attention to the derivative origin of species. Hence to naturalists, and particularly ornithologists, the Galapagos Islands will ever be classic ground.

Unhappily, the advent of man, with his retinue of goats, pigs, cats and rats, has already resulted in the extermination of at least one of the indigenous birds; others are threatened with the same fate. The extinction of an animal is always a matter of regret, and in the present case is a serious loss to science because of certain unsolved problems respecting the extraordinary and unique interrelations of many of the species. For instance, certain genera contain a large number of forms, alike in color and markings, but differing in proportions, particularly the size and shape of the bill. In one genus (*Geospiza*) the bill presents a series of types which at first would hardly be supposed to fall within the limits of a single family, —much less a single genus. This remarkable series comprises bills that in form and size resemble those of tanagers, small-billed sparrows and huge-billed grosbeaks. But for the existence of intermediate forms no one would think of placing such diverse kinds in a single genus. In one or two of the genera almost every conceivable stage and step of intergradation exists, so that it becomes extremely difficult—if not in some cases impossible—to draw the line between specific and individual variations.

Owing to the absence of information concerning the adaptations and limits of specific varia-

tion among these birds in life, and owing further to the fact that certain species are on the verge of extermination, while others doubtless still remain to be discovered, it is clearly of pressing importance that some competent ornithologist should visit the islands and study the habits and interrelations of the various forms before it is too late.

In recent years relatively large collections of birds have been made on some of the islands. Those obtained by the naturalists of the 'Albatross' in 1888 and 1891, and by Dr. George Baur and Mr. Adams in 1891, were brought to the U. S. National Museum, where they have been critically studied by Mr. Ridgway. The result is the present admirable paper entitled '*Birds of the Galapagos Archipelago*,' one of the most important ornithological publications that has appeared in many years. It is a comprehensive treatise 'intended,' as the author tells us, 'to embody practically all that it known of the avi-fauna' of the region. Still "it does not claim to be exhaustive, for a great deal has yet to be learned before anything like a complete exposition of the subject is possible."

Respecting the conflicting theories as to the origin of the Galapagos Mr. Ridgway states: "All writers are agreed that the Galapagos Islands are volcanic; nearly all, from Darwin to Agassiz, agree that they were uplifted from the sea by volcanic action, and that their upheaval therefore antedates the advent of organic life upon them. Dr. Baur, however, believes that these islands are the higher points of an extensive submerged area, whose subsidence took place after a fauna and flora had been acquired; or, to quote his own words: 'At a former period these islands were connected with each other, forming a single large island, which itself at a still earlier time was united to the continent, probably with Central America and the West Indies.'"

Mr. Ridgway modestly adds that he is "not competent to discuss the relative merits of these two opposite theories from the physiographer's standpoint; but if the apparent relationships of the fauna have any bearing on the question," he believes Dr. Baur's theory 'at least worthy of serious consideration.' He calls attention to the map accompanying Alexander Agassiz's report on the cruise of the 'Albatross' for 1891, which shows that the Galapagos and Cocos Islands stand on a submarine plateau covered by only 1,500 fathoms of water, and that this plateau reaches northeasterly to within 100 miles of the present coast of Central America, and is only a little more than 80 miles distant from the 1,500-fathom coast-line. These distances are too insignificant to form any barrier to the free passage of birds; hence, if it can be assumed that the present submarine plateau was ever above the level of the sea it would naturally have received its original bird population from Central America. Let us see how this accords with the facts of present distribution. Mr. Ridgway tells us that 38 genera of birds are believed to breed on the islands. Of these, 23 are wide ranging, 6* are peculiar to the islands, and 7 are tropical American. Eliminating the wide-ranging genera, 13 remain, of which 6 are peculiar and all of the others tropical American. Mr. Ridgway then takes up the 5* peculiar genera and discusses each with respect to its relationships and probable origin. After stating that two of these are clearly of American origin, that two resemble both American and Hawaiian types, and that the remaining one "has no very near relative among the known continental or West India birds, but in general appearance is very much like a smaller 'edition' of the Hawaiian genus *Oreomyza*," he sums up as follows: "Of the five peculiar Galapagoan genera of birds, only two (*Nesomimus* and *Nesopelia*) are of evident American relationship. The remaining three have so obvious a leaning toward certain Hawaiian dicæidine forms that the possibility of a former land connection, either continuous or by means of intermediate islands as 'stepping stones,' becomes a factor in the problem. It may be that the resemblance of *Cocornis*, *Cactornis* and *Camarhynchus* to the above mentioned *Hawaiian* forms is merely a superficial one, and not indicative of real relationship. I do not by any

* By a singular slip the number of peculiar genera given in the tables and on page 465 is 6, while two pages later it is reduced to 5. The latter number is the result of uniting *Cactornis* with *Geospiza* after the earlier pages were written. By an oversight this was not corrected in the proof.

means claim, on the strength of such evidence, a common origin for them, but merely present the facts as 'food for reflection.'"

In discussing the extraordinary conditions presented in the genus *Geospiza*, Mr. Ridgway states: "When it is remembered that the coloration is practically, if not absolutely, the same in all of the twenty-odd forms of the genus *Geospiza*, it will be seen that if any segregation of species is made at all it must be based upon measurements; and when it is further seen that there is a gradual transition from the enormous beak of *G. magnirostris* to the comparatively minute one of *G. parvula* and from the excessively thick one of *G. pachyrhyncha* (whose lateral outlines approximate an equilateral triangle) to the slender and curved one of *G. scandens* or the acuminate one of *G. acutirostris;* and that size of beak is not necessarily correlated with length of wing, tarsus, etc., the difficulty of defining species becomes obvious. * * * Having been perplexed by these difficulties I have carefully weighed all doubtful cases, and whenever there seemed to be a well defined average difference between specimens from different islands I have not hesitated to separate them as local forms. No other course, indeed, is practicable; for were 'lumping' once begun there could be no end to it, unless purely arbitrary limits were given to the species recognized, and if followed to a logical conclusion might easily end in the recognition of a single variable species, equivalent in its limits to the genus."

In an earlier paper Mr. Ridgway united the genera *Cactornis* and *Geospiza* because of intergradation; in the present paper *Cactornis* is retained in a subgeneric sense. Mr. Ridgway quotes a letter from Dr. Baur as follows: "You place the species of these two genera in one genus, *Geospiza*. I do not think that this is natural. Both have their peculiar representatives on the different islands, and if you place them together this peculiar differentiation of each is lost sight of. *Cactornis* is more slender than *Geospiza* and has many more black individuals. I would keep the two genera apart." Dr. Baur might have strengthened his position by adding that genera should be based on degree of differentiation rather than on the survival or non-survival of intergrades. The present case is unusually extreme, because a complete chain of intermediate 'species' is known to exist, connecting the slender-billed *Cactornis* type with the thick-billed *Geospiza* type. But in all cases of derivative genera the theory of evolution, conceived on these very islands, calls for the existence at one time or another of similar chains of intergrades. Whether such intergrades survive, bridging the extremes with living forms, or die off, leaving the extremes trenchantly defined, is a matter of zoological interest, but one in no way affecting the degree of differentiation of the extremes, on which alone, in my judgment, the question of generic distinctness should rest.

Chronologic lists of the species found on each island by the various explorers, from Darwin in 1835 to Townsend, Baur and Adams in 1891, are given, and also an exceedingly convenient tabular statement showing in 16 columns the various islands on which each of the 105 species is known to occur. This is followed by the systematic part of the paper, comprising keys, maps and careful descriptions of the various genera and species. The map used is a skeleton, covering considerably more than a half page, on which range is indicated by heavy-face numerals. Since this map is introduced about 50 times the waste space at the top and bottom adds materially to the size of the paper. Two plates are given showing the astonishing variations in the size and form of the bill in the genera *Nesomimus*, *Camarhynchus* and *Geospiza*. The paper closes with a bibliography of 23 titles. The technical descriptions are models of thorough painstaking work, and the memoir as a whole easily takes a place among the classics of ornithology.

By an utterly unpardonable blunder, for which the author is in no way responsible, the cover-title-page is dated 1896, although not published until March, 1897. Accidents are liable to occur anywhere, but the number of papers bearing the cherished imprint of the Smithsonian Institution which are permitted to appear under ostensible dates that materially antedate the actual date of publication is not only an injustice to the author and an annoy-

ance to the bibliographer, but is hardly creditable to the spirit of scientific accuracy and fairness which American science has done so much to promote.

C. H. M.

The Mechanics of Pumping Machinery. By J. WEISBACH and G. HERRMANN. Authorized Translation by K. P. DAHLSTROM, M. E. Macmillan & Co. 1897. Pp. 300. 8vo. $3.75.

This work is a translation of the latest division of the Weisbach cyclopedic treatise on Engineering Mechanics. It is intended mainly as a text-book, and for use in advanced courses of instruction in engineering schools; while it is also thought that it may have value to the designer and constructor in his daily work. The translator has added some matter exhibiting the progress made in this field since the original publication of the book in Germany, and in this he has had the aid of Professor Klein's notes. The work includes discussions of early forms of water elevators and hydraulic machinery, of the theory and action of pumps, both reciprocating and rotary, and an account of other less well-known apparatus for raising water. The reputation of the author, Professor Herrmann, the distinguished technicist, is a guarantee of the reliability of these discussions, and this guarantee is confirmed by examination of the pages of this translation, in which these discussions have been faithfully brought over into the English and in satisfactory form.

The illustrations are numerous and helpful; the text is by them rendered admirably lucid. In general appearance and style the volume corresponds to its predecesors in the same series and, without being elegant, is creditably made up. Its price is moderate and it will probably find its place in the library of all who possess its companion volumes.

R. H. T.

SCIENTIFIC JOURNALS.

THE JOURNAL OF COMPARATIVE NEUROLOGY. VOL. VII., NO. 1.

THE issue for April contains three memoirs, besides editorials and reviews. B. F. Kingsbury writes on 'The Structure ard Morphology of the Oblongata in Fishes,' from the standpoint of the components of the nerve roots. Some 17 species of cartilaginous and bony fishes were examined, their nerve roots analyzed and the components traced to their respective centers, along the lines laid down by Strong's recent work on the cranial nerves of Amphibia. It will be remembered that Strong reduces the sensory nerves of the head to three types: (1) the general cutaneous system, innervating the skin and terminating in the 'ascending' or spinal fifth tract of the medulla; (2) the acustico-lateral system, innervating the lateral line canals and the ear and terminating in the tuberculum acusticum of the medulla; (3) the fasciculus communis system, innervating taste buds, certain specialized end-organs of the skin not belonging to the lateral line system, and the mucous and visceral surfaces in general, and terminating in the fasciculus communis of the medulla, or the cellular aggregates associated with it (lobus vagi of fishes).

Now in the fishes examined, Dr. Kingsbury finds these components present, and arranged in essentially the same way as in the Amphibia. The varied and apparently anomalous conditions found in the medulla of the fishes, which have so long puzzled the morphologists, have been reduced for the most part to variations in the relative development of these three factors. The lobus trigemini of the catfishes is regarded as a specialized portion of the fasciculus communis system. These conclusions have been reached by a study of the central relations only of the nerve roots. It may be added that researches now in progress at Columbia University, upon the peripheral distribution of these roots in the bony fishes, have fully substantiated most of his discoveries.

Dr. Kingsbury follows with a second paper entitled 'The Encephalic Evaginations in Ganoids.' The new and important points are two: (1) The presence in the adult Amia of the first epiphysial vesicle of Hill and its innervation from the left Habena; and (2) the existence in Amia and Lepidosteus of lateral cephalic and caudal extensions of cavity caudad of the velum transversum of Kupffer, constituting considerable diverticula.

'The Early Development of the Epiphysis and

Paraphysis in Amia,' by A. C. Eycleshymer and B. M. Davis. This paper describes and fully illustrates the early development of the same structures treated in the preceding article; each, therefore, supplements the other. The first vesicle of Hill (*i. e.*, the smaller more cephalic vesicle and the one termed 'secondary vesicle' by Eycleshymer and Davis) arises as an evagination from the dorsal wall of the other vesicle and some four or five days later.

It then shifts to the left side (occasionally to the right) and in one instance was seen to receive nerve fibers from the superior commissure. A critical review of the theories of the relation of the epiphysial outgrowths to the segmental sense organs follows.

The editor-in-chief gives a few aphorisms on 'The Ethics of Criticism,' which, though trite, are not, perhaps, wholly unnecessary.

SOCIETIES AND ACADEMIES.

CHEMICAL SOCIETY OF WASHINGTON; THE 94TH REGULAR MEETING, MARCH 11.

THE first paper, 'Some Theories of Crystal Structure,' was by Mr. Wirt Tassin. After reviewing earlier hypothesis the author took up the more recent structural theory of Federow and Schonflies, which requires only that the structure of the crystal consist of similar molecules and allows the chemist and the physicist to decide the character of these molecules. It was pointed out that the essential difference between the Sohnckian hypothesis and that of Schonflies was that Sohncke requires that, in a system of points which is to have the characters required by a crystal structure, around every point the arrangement of the remainder is the same as around every other point; and all of his structures are derived by moving one point to another by sliding, rotating and screw motions. Schonflies, on the other hand, defines a crystal as 'consisting of absolutely similar molecules, so arranged that each molecule is environed in the same way by all the other molecules,' so that one part of the system may be derived from the other by reflection. Mention was made of Harlow's work and examples given, and the paper closed with a list of predictions of new compounds which have been verified and which were based upon theories treating of the relations between form, structure and composition.

As a supplement to Mr. Tassin's paper, Dr. F. K. Cameron read a short résumé on 'The Effect of Substitution on Isomorphism and Crystal Structure in Organic Compounds.' Substitution may cause the system to increase or diminish in symmetry or may cause the lengthening or shortening of axes. With the substitution of one or a few atoms by other atoms or groups the system generally changes and to one of less symmetry. If all, or nearly all, the equivalent atoms or groups are placed alike the derivative generally regains the symmetry of the original substance. The effect of substitution on crystal structure was illustrated by a comparison of the benzol and of the ammonium platino-chloride compounds. Neither (OH) nor (NO_2) seem to have much morphotropic value. Repeated substitution in the platino-chlorides often restores the symmetry of the mother substance, but the substitution of ethyl brings about a complete change.

Messrs. Wm. H. Krug and J. E. Blomen presented a paper, entitled 'A Recalculation of Wein's Table of Starch Equivalent to Copper Found Based on the Factor 0.92.' Starch or dextrine can be directly obtained from the copper found by converting the starch into dextrine and determining the latter with Allihn's solution. This table is based on the factor 0.90, which assumes that the formula of starch is $(C_6H_{10}O_5)n$ and that it is all converted into dextrose. Nägelli determined the formula of starch to be $C_{36}H_{62}O_{31}$ and if this is correct the factor becomes 0.918. Ost, working with the Sacchse method, decided upon the factor 0.925. In view of all these conflicting data Wiley recommends the factor 0.92, a man between the two last cited, which will give the analyst fairly accurate results. This factor has been used in the recalculation of the table.

The last paper, entitled 'Malt Wine,' was read by Dr. D. J. Kelly. He pointed out how Ordonneau, Jacquemin, Tettelin, Rommier and Sauer recognized the profound changes produced in the fermentation of a sweet liquid according to the kind of ferment employed. They found that when the juice of

a poorer variety of grape was fermented by the aid of the ferment peculiar to a choicer kind it became a wine having many of the characteristic properties of the better kind; a solution of sugar and water, to which appropriate yeast food and then wine ferment was added, was fermented and submitted to distillation; the result resembled brandy. When ordinary malt-wort is sterilized, and then, instead of being fermented with the usual saccharomyces cerevisiæ, or brewers' yeast, is fermented with the saccharomyces ellipsoidcus, or fruit yeast, the resulting liquid resembles a fruit wine, and the liquid distilled therefrom a brandy. In his recently patented process Sauer ferments a sterilized malt-wort by a pure culture of a ferment derived from the bloom of the sherry or the Tokay grape, modifying the old process in certain important details, and obtains wine specimens of which were submitted to the audience and pronounced to be scarcely distinguishable, if at all, from the genuine articles. Dr. Kelly suggested that possibly the substitution of a properly selected grape or other wine yeast for that now employed in the process of bread making might be found to modify very agreeably this article of daily consumption.

V. K. CHESNUT,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO—MEETING OF APRIL 14, 1897.

THE results of a study of the marine fauna of San Diego Bay, Cal., during January, February and March of the current year were presented. Specimens of most of the forms alluded to in the lecture were exhibited, among others *Renilla amethystina*, five new species of Polyclads, specimens of the Annelids *Phyllodoce*, *Polyophthalmus* and a huge *Amphitrite*, with its giant commensal *Polynoë*, specimens of several Crustaceans (two species of *Callianassa*, *Limnoria terebrans*, with wood showing its borings, *Pollicipes polymerus* and its egg masses, etc.). Several species of Polyplacophora, Opisthobranchs and specimens of *Octopus punctatus* were exhibited. Special attention was devoted to the Dicyemidæ, collected from the kidneys of over 100 *Octopus*. It was shown that three species of this peculiar group of parasites may be recognized on the Pacific coast, each belonging to a different genus and all new to science. There is a species of *Dicyema* to which the name *D. coluber* may be given and which, like its European congeners, has *four* metapolar cells in its calotte. A species of Professor Whitman' genus *Dicyemennea* and named *D. Whitmanii* has *five* metapolars. The third species belongs to a new genus which will be called *Dicyemodeca* (*D. sceptrum*, n. sp.). It has *six* metapolars an the parapolars are very short and broad, clasping the bases of the inflated metapolars like a collar. All the Pacific Dicyemidæ observed have orthotropal calottes. Some new facts concerning the sequence of the two peculiar forms of embryo during the life of the parent *Dicyema* were presented. In its youth *Dicyema* produces only the so-called vermiform embryos, but later only infusoriform embryos are developed within the axial cell. This is the reverse of the sequence formerly advocated by Professor Whitman, and would seem to indicate a relationship of the Dicyemidæ to certain Plathelminths; the series of vermiform embryos being perhaps comparable to the sporocyst and redia generations, the infusoriform embryo to the cercarian stage of the Trematodes. According to this view the adult of *Dicyema* is still to be found.

Of the Chordata several forms were exhibited —specimens of a huge red *Cynthia* and masses of *Ciona intestinalis* from the piles at Coronado, also several specimens of *Branchiostoma* (*Amphioxus*) *elongatum* (one measuring 90 mm.), dredged near the entrance to San Diego Bay. Considerable attention was paid to the viviparous Teleosts, more than forty species of which (Scorpænidæ and Embiotocidæ) occur at San Diego. These are all shore fishes and have become viviparous in adaptation to their littoral habitat. If the eggs were laid loosely in the water and allowed to float like the pelagic fish eggs they would readily drift ashore and perish; if attached to the rocks or bottom they would easily be destroyed by predaceous members of the very rich littoral fauna, unless guarded by the parent fish, as in the case of *Porichthys*, or hidden away under stones, as in the case of some of the Pacific shore fishes. When it is remembered that many of the viviparous Teleosts (especially the Embiotocidæ) live in

the surf on sandy beaches it will be seen that viviparity is a necessary condition of existence with these forms. A full series of the eggs and embryos of *Cymatogaster aggregatus* and the adults of this and five other species of Embiotocidæ were exhibited. Attention was also called to a number of specimens of the singular little blind fish (*Typhlogobius californiensis*, which lives in the burrows of *Callianassa* under rocks at Point Loma, near San Diego.

WILLIAM MORTON WHEELER.

NEW YORK ACADEMY OF SCIENCES—SUB-SECTION OF PSYCHOLOGY AND ANTHROPOLOGY, APRIL 26, 1897.

THE Academy met with Professor Thomas R. Price in the chair. The following papers were presented: 'Mental Imagery,' by Mr. W. Lay. The paper was a brief report of the result of two years' study and research. Of one hundred and twenty-five New York artists, the speaker found but three or four who exhibited the extraordinary degree of the power of visualizing which might be looked for in individuals trained to observe things from a purely pictorial standpoint. One hundred and fifty college students gave the same result. The speaker described the methods and gave the results of his experiments on himself to determine in terms of what sense the content of his own train of thought was chiefly composed. He has studied also the elements of mental imagery to be discovered in language and the visual, auditory and other imagery in poetry.

'Visual After-images,' by Mr. S. I. Franz. The speaker first described a typical after-image and referred to the interest the phenomena had aroused, as shown by the number of prominent scientists that had discussed them. Their importance was shown both for a correct theory of color vision and epistemologically as connecting links between sensation and memory and imagination. Experiments on the production (*i. e.*, the threshold) and on the duration were then described, and curves showing the results obtained were exhibited. The psychic relations of the different physical variables (viz. time, area and intensity) were discussed. The great individual variations, particularly in the coloration, showed that the after-image is not simple but exceedingly complex, and that the present theories to explain the phenomena are inadequate.

LIVINGSTON FARRAND,
Secretary pro tem.

THE ACADEMY OF SCIENCES OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis, held on the evening of May 3, 1897, 21 persons present, Mr. H. Von Schrenk spoke of the respiration of plants, with special reference to the modification of those growing with their roots submerged in water. The lecture was illustrated by a demonstration of the liberation of carbon dioxide in respiration, from the roots of an ordinary flowering plant and freshly gathered fungi, and the more usual ærenchyma structures were made clear by the use of lantern slides.

Professor F. E. Nipher described a simple means of measuring the resistance of a tube to the flow of a current of air, when compared with an accepted standard, by the use of a tubular device similar in principle to the Wheatstone bridge, used in electrical instruments; the apparatus, in the present instance, consisting of parallel tubes filled with air, connected by a tubular bridge, in the middle of which a drop of water was placed, so as to change position with the variations in the flow of air on the one hand or on the other.

WILLIAM TRELEASE,
Secretary.

NEW BOOKS.

The Development of the Frog's Eggs; an Introduction to Experimental Embryology. THOMAS HUNT MORGAN. New York and London, The Macmillan Company. 1897. Pp. x+192.

Navahoe Legends, collected and translated by WASHINGTON MATTHEWS. Boston and New York, Houghton, Mifflin & Co. 1897. Pp. viii+299.

Introductory Course in Differential Equations. D. A. MURRAY. New York, London and Bombay, Longmans, Green & Co. 1897. Pp. xv+234.

The Science of Speech. ALEXANDER MELVILLE BELL. Washington, D. C., The Volta Bureau. 1897. Pp. 56.

SCIENCE

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FRIDAY, MAY 21, 1897.

CONTENTS:

The Problems of Astronomy: SIMON NEWCOMB.....777
The Recent Visit of Sir Archibald Geikie: J. F. KEMP.785
Sir Archibald Geikie on a Comparison between the Tertiary Volcanic Succession in Northwestern Europe and in Western America: W. F. MORSELL..788
Some Phases in Weed Evolution: F. A. WAUGH...789
The Effect of the Density of the Surrounding Gas on the Discharge of Electrified Metals by X-Rays: C. D. CHILD.....791
Current Notes on Physiography:—
Cornish on Sand Dunes; Philippson on Geomorphology; Thorodssen on Northeast Iceland; Volcanic Phenomena of 1894; Limestone Range of the Klonthal, Switzerland: W. M. DAVIS.....795
Current Notes on Anthropology:—
The Notes on American Ceramics; The Racial Geography of Europe; Another Interpreter of the Mayan Hieroglyphs: D. G. BRINTON.....797
Notes on Inorganic Chemistry: J. L. H.....798
Scientific Notes and News:—
A Permanent Census Bureau; The Elizabeth Thompson Science Fund; General.....799
University and Educational News.....803
Discussion and Correspondence:—
Former Extension of Ice in Greenland: RALPH S. TARR. *Poudré:* LUDOVIC ESTES. *Earliest Published Note of the late Chas. E. Bendire:* C. H. M.. 804
Scientific Literature:—
Recent Text-books of Physics. Sergi's Antropologia della Stirpe Camitica: D. G. BRINTON. *M'Kendrick's Elementary Human Physiology.* JOSEPH W. WARREN. *Martin's Story of a Piece of Coal:* J. J. STEVENSON.....805
Societies and Academies:—
Biological Society of Washington: F. A. LUCAS. *The Geological Society of Washington:* W. F. MORSELL. *Science Club of the Northwestern University:* THOMAS F. HOLGATE. *The Texas Academy of Science:* FREDERIC W. SIMONDS.....810
New Books.....812

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THE PROBLEMS OF ASTRONOMY.*

ASSEMBLED, as we are, to dedicate a new institution to the promotion of our knowledge of the heavens, it appeared to me that an appropriate and interesting subject might be the present and future problems of astronomy. Yet it seemed, on further reflection, that, apart from the difficulty of making an adequate statement of these problems on such an occasion as the present, such a wording of the theme would not fully express the idea which I wish to convey. The so-called problems of astronomy are not separate and independent, but are rather the parts of one great problem, that of increasing our knowledge of the universe in its widest extent. Nor is it easy to contemplate the edifice of astronomical science as it now stands, without thinking of the past as well as of the present and future. The fact is that our knowledge of the universe has been in the nature of a slow and gradual evolution, commencing at a very early period in human history, and destined to go forward without stop, as we hope, so long as civilization shall endure. The astronomer of every age has built on the foundations laid by his predecessors, and his work has always formed, and must ever form, the base on which his successors shall build. The astronomer of to-day may look

*An address given by Professor Simon Newcomb at the dedication of the Flower Observatory, University of Pennsylvania, May 12, 1897.

back upon Hipparchus and Ptolemy as the earliest ancestors of whom he has positive knowledge. He can trace his scientific descent from generation to generation, through the periods of Arabian and mediæval science, through Copernicus, Kepler, Newton, La Place and Herschel, down to the present time. The evolution of astronomical knowledge, generally slow and gradual, offering little to excite the attention of the public, has yet been marked by two cataclysms. One of these is seen in the grand conception of Copernicus that this earth on which we dwell is not a globe fixed in the center of the universe, but is simply one of a number of bodies, turning on their own axes and at the same time moving around the sun as a center. It has always seemed to me that the real significance of the heliocentric system lies in the greatness of this conception rather than in the fact of the discovery itself. There is no figure in astronomical history which may more appropriately claim the admiration of mankind through all time than that of Copernicus. Scarcely any great work was ever so exclusively the work of one man as was the heliocentric system the work of the retiring sage of Frauenburg. No more striking contrast between the views of scientific research entertained in his time and in ours can be seen than that seen in the fact that, instead of claiming credit for his great work, he deemed it rather necessary to apologize for it and, so far as possible, to attribute his ideas to the ancients.

A century and a half after Copernicus followed the second great step, that taken by Newton. This was nothing less than showing that the seemingly complicated and inexplicable motions of the heavenly bodies were only special cases of the same kind of motion, governed by the same forces, that we see around us whenever a stone is thrown by the hand or an apple falls to the ground. The actual motions of the heavens and the laws which govern them being known, man had the key with which he might commence to unlock the mysteries of the universe.

When Huyghens, in 1656, published his *Systema Saturnium*, where he first set forth the mystery of the rings of Saturn, which, for nearly half a century, had perplexed telescopic observers, he prefaced it with a remark that many, even among the learned, might condemn his course in devoting so much time and attention to matters far outside the Earth, when he might better be studying subjects of more concern to humanity. Notwithstanding that the inventor of the pendulum clock was, perhaps, the last astronomer against whom a neglect of things terrestrial could be charged, he thought it necessary to enter into an elaborate defense of his course in studying the heavens. Now, however, the more distant objects are in space—I might almost add the more distant events are in time—the more they excite the attention of the astronomer, if only he can hope to acquire positive knowledge about them. Not, however, because he is more interested in things distant than in things near, but because thus he may more completely embrace in the scope of his work the beginning and the end, the boundaries of all things, and thus, indirectly, more fully comprehend all that they include. From his standpoint

> "All are but parts of one stupendous whole,
> Whose body nature is and God the soul."

Others study nature and her plans as we see them developed on the surface of this little planet which we inhabit; the astronomer would fain learn the plan on which the whole universe is constructed. The magnificent conception of Copernicus is, for him, only an introduction to the yet more magnificent conception of infinite space containing a collection of bodies which we call

the visible universe. How far does this universe extend? What are the distances and arrangements of the stars? Does the universe constitute a system? If so, can we comprehend the plan on which this system is formed, of its beginning and of its end? Has it bounds outside of which nothing exists but the black and starless depths of infinity itself? Or are the stars we see simply such members of an infinite collection as happen to be the nearest our system? A few such questions as these we are perhaps beginning to answer; but hundreds, thousands, perhaps even millions of years may elapse without our reaching a complete solution. Yet the astronomer does not view them as Kantian antinomies, in the nature of things insoluble, but as questions to which he may hopefully look for at least a partial answer.

The problem of the distances of the stars is of peculiar interest in connection with the Copernican system. The greatest objection to this system, which must have been more clearly seen by astronomers themselves than by any others, was found in the absence of any apparent parallax of the stars. If the earth performed such an immeasurable circle around the sun as Copernicus maintained, then, as it passed from side to side of its orbit, the stars outside the solar system must appear to have a corresponding motion in the other direction, and thus to swing back and forth as the earth moved in one and the other direction. The fact that not the slightest swing of that sort could be seen was, from the time of Ptolemy, the basis on which the doctrine of the earth's immobility rested. The difficulty was simply ignored by Copernicus and his immediate successors. The idea that Nature would not squander space by allowing immeasurable stretches of it to go unused seems to have been one from which mediæval thinkers could not entirely break away. The consideration that there could be no need of any such economy, because the supply was infinite, might have been theoretically acknowledged, but was not practically felt. The fact is that magnificent as was the conception of Copernicus, it was dwarfed by the conception of stretches from star to star so vast that the whole orbit of the earth was only a point in comparison.

An indication of the extent to which the difficulty thus arising was felt is seen in the title of a book published by Horrebow, the Danish astronomer, some two centuries ago. This industrious observer, one of the first who used an instrument resembling our meridian transit of the present day, determined to see if he could find the parallax of the stars by observing the intervals at which a pair of stars in oppposite quarters of the heavens crossed his meridian at opposite seasons of the year. When, as he thought, he had won success he published his observations and conclusions under the title of '*Copernicus Triumphans.*' But alas! the keen criticism of his contemporaries showed that what he supposed to be a swing of the stars from season to season arose from a minute variation in the rate of his clock, due to the different temperatures to which it was exposed during the day and the night. The measurement of the distance even of the nearest stars evaded astronomical research, until Bessel and Struve arose in the early part of the present century.

On some aspects of the problem of the extent of the universe light is being thrown even now. Evidence is gradually accumulating which points to the probability that the successive orders of smaller and smaller stars, which our continually increasing telescopic power brings into view, are not situated at greater and greater distances, but that we actually see the boundary of our universe. This indication lends a peculiar interest to various questions growing out of the motions of the stars. Quite pos-

sibly the problem of these motions will be the great one of the future astronomer. Even now it suggests thoughts and questions of the most far-reaching character.

I have seldom felt a more delicious sense of repose than when crossing the ocean during the summer months I sought a place where I could lie alone on the deck, look up at the constellations, with *Lyra* near the zenith, and, while listening to the clank of the engine, try to calculate the hundreds of millions of years which would be required by our ship to reach the star α Lyræ if she could continue her course in that direction without ever stopping. It is a striking example of how easily we may fail to realize our knowledge when I say that I have thought many a time how deliciously one might pass those hundred millions of years in a journey to the star α Lyræ, without its occurring to me that we are actually making that very journey at a speed compared with which the motion of a steamship is slow indeed. Through every year, every hour, every minute, of human history from the first appearance of man on the earth, from the era of the builders of the Pyramids, through the times of Cæsar and Hannibal, through the period of every event that history records, not merely our earth, but the sun and the whole solar system with it, have been speeding their way toward the star of which I speak on a journey of which we know neither the beginning nor the end. During every clock-beat through which humanity has existed it has moved on this journey by an amount which we cannot specify more exactly than to say that it is probably between five and nine miles per second. We are at this moment thousands of miles nearer to α Lyræ than we were a few minutes ago when I began this discourse, and through every future moment, for untold thousands of years to come, the earth and all there is on it will be nearer to α Lyræ, or nearer to the place where that star now is, by hundreds of miles for every minute of time come and gone. When shall we get there? Probably in less than a million years, perhaps in half a million. We cannot tell exactly, but get there we must if the laws of nature and the laws of motion continue as they are. To attain to the stars was the seemingly vain wish of the philosopher, but the whole human race is, in a certain sense, realizing this wish as rapidly as a speed of six or eight miles a second can bring it about.

I have called attention to this motion because it may, in the not distant future, afford the means of approximating to a solution of the problem already mentioned, that of the extent of the universe. Notwithstanding the success of astronomers during the present century in measuring the parallax of a number of stars, the most recent investigations show that there are very few, perhaps hardly more than a score of stars of which the parallax, and therefore the distance, has been determined with any approach to certainty. Many parallaxes, determined by observers about the middle of the century, have had to disappear before the powerful tests applied by measures with the heliometer; others have been greatly reduced, and the distances of the stars increased in proportion. So far as measurement goes, we can only say of the distances of all the stars, except the few whose parallaxes have been determined, that they are immeasurable. The radius of the earth's orbit, a line more than ninety millions of miles in length, not only vanishes from sight before we reach the distance of the great mass of stars, but becomes such a mere point that, when magnified by the powerful instruments of modern times, the most delicate appliances fail to make it measurable. Here the solar motion comes to our help. This motion, by which, as I have said, we are carried unceasingly

through space, is made evident by a motion of most of the stars in the opposite direction, just as, passing through a country on a railway, we see the houses on the right and on the left being left behind us. It is clear enough that the apparent motion will be more rapid the nearer the object. We may, therefore, form some idea of the distance of the stars when we know the amount of the motion. It is found that, in the great mass of stars of the sixth magnitude, the smallest visible to the naked eye, the motion is about three seconds per century. As a measure thus stated does not convey an accurate conception of magnitude to one not practiced in the subject, I would say that, in the heavens, to the ordinary eye, a pair of stars will appear single unless they are separated by a distance of 150 or 200 seconds. Let us then imagine ourselves looking at a star of the sixth magnitude, which is at rest while we are carried past it with the motion of six or eight miles per second which I have described. Mark its position in the heavens as we see it to-day; then let its position again be marked 5,000 years hence. A good eye will just be able to perceive that there are two stars marked instead of one. The two would be so close together that no distinct space between them could be perceived by unaided vision. It is due to the magnifying power of the telescope, enlarging such small apparent distances, that the motion has been determined in so small a period as the 150 years during which accurate observations of the stars have been made.

The motion just described has been fairly well determined for what astronomically speaking are the brighter stars, that is to say those visible to the naked eye. But how is it with the millions of faint telescopic stars, especially those which form the cloud masses of the Milky Way? The distance of these stars is undoubtedly greater, and the apparent motion is, therefore, smaller. Accurate observations upon such stars have been commenced only recently, so that we have not yet had time to determine the amount of the motion. But the indication seems to be that it will prove quite a measurable quantity, and that before the twentieth century has elapsed it will be determined for very much smaller stars than those which have heretofore been studied. A photographic chart of the whole heavens is now being constructed by an association of observatories in some of the leading countries of the world. I cannot say all the leading countries, because then we should have to exclude our own, which, unhappily, has taken no part in this work. At the end of the twentieth century we may expect that the work will be repeated. Then, by comparing the charts, we shall see the effect of the solar motion and, perhaps, get new light upon the problem in question.

Closely connected with the problem of the extent of the universe is another which appears, for us, to be insoluble because it brings us face to face with infinity itself. We are familiar enough with eternity, or, let us say, the millions or hundreds of millions of years which geologists tell us must have passed while the crust of the earth was assuming its present form, our mountains being built, our rocks consolidated, and successive orders of animals coming and going. Hundreds of millions of years is, indeed, a long time, and yet, when we contemplate the changes supposed to have taken place during that time, we do not look out on eternity itself, which is veiled from our sight, as it were, by the unending succession of changes that mark the progress of time. But in the motions of the stars we are brought face to face with eternity and infinity, covered by no veil whatever. It would be bold to speak dogmatically on a subject where the springs of

being are so far hidden from mortal eyes as in the depths of the universe. But, without declaring its positive certainty, it must be said that the conclusion seems unavoidable that a number of stars are moving with a speed such that the attraction of all the bodies of the universe could never stop them. One such case is that of Arcturus, the bright reddish star familiar to mankind since the days of Job, and visible near the zenith on the clear evenings of May and June. Yet another case is that of a star known in astronomical nomenclature as 1830 Groombridge, which exceeds all others in its angular proper motion, as seen from the earth. We should naturally suppose that it seems to move so fast because it is near us. But the best measurements of its parallax seem to show that it can scarcely be less than two million times the distance of the earth from the sun, while it may be much greater. Accepting this result, its velocity cannot be much less than 200 miles per second, and may be much more. With this speed it would make the circuit of our globe in two minutes, and had it gone round and round in our latitudes we should have seen it fly past us a number of times since I commenced this discourse. It would make the journey from the earth to the sun in five days. If it is now near the center of our system it would probably reach its confines in a million of years. So far as our knowledge of nature goes, there is no force in nature which would ever have set it in motion, and no force which can ever stop it. What, then, was the history of this star, and if there are planets circulating around, what the experience of beings who may have lived on those planets during the ages which geologists and naturalists assure us our earth has existed? Did they see, at night, only a black and starless heaven? Was there a time when, in that heaven, a small faint patch of light began gradually to appear? Did that patch of light grow larger and larger as million after million of years elapsed? Did it at last fill the heavens and break up into constellations as we now see them? As millions more of years elapse will the constellations gather together in the opposite quarter, and gradually diminish to a patch of light as the star pursues its irresistible course of 200 miles per second through the wilderness of space, leaving our universe farther and farther behind it, until it is lost in the distance? If the conceptions of modern science are to be considered as good for all time, a point on which I confess to a large measure of scepticism, then these questions must be answered in the affirmative.

Intimately associated with these problems is that of the duration of the universe in time. The modern discovery of the conservation of energy has raised the question of the period during which our sun has existed and may continue in the future to give us light and heat. Modern science tells us that the quantity of light and heat which can be stored in it is necessarily limited, and that, when radiated as the sun radiates, the supply must in time be exhausted. A very simple calculation shows that were there no source of supply the sun would be cooled off in three or four thousand years. Whence, then, comes the supply? During the past thirty years the source has been sought for in a hypothetical contraction of the sun itself. True, this contraction is too small to be observed; several thousand years must elapse before it can be measurable with our instruments. Granting that this is and always has been the sole source of supply, a simple calculation shows that the sun could scarcely have been giving its present amount of heat for more than twenty or thirty millions of years. Before that time the earth and the sun must have formed one body, a great nebula, by the condensation of which both are supposed to have been formed. But

the geologists tell us that the age of the earth is to be reckoned by hundreds of millions of years. Thus arises a question to which physical science has not been able to give an answer.

The problems of which I have so far spoken are those of what may be called the older astronomy. If I apply this title it is because that branch of the science to which the spectroscope has given birth is often called the new astronomy. It is commonly to be expected that a new and vigorous form of scientific research will supersede that which is hoary with antiquity. But I am not willing to admit that such is the case with the old astronomy, if old we may call it. It is more pregnant with future discoveries to-day than it ever has been, and it is more disposed to welcome the spectroscope as a useful hand-maid, which may help it on to new fields, than it is to give way to it. How useful it may thus become has been recently shown by a Dutch astronomer, who finds that the stars having one type of spectrum belong mostly to the Milky Way, and are farther from us than the others.

In the field of the newer astronomy perhaps the most interesting work is that associated with comets. It must be confessed, however, that the spectroscope has rather increased than diminished the mystery which, in some respects, surrounds the constitution of these bodies. The older astronomy has satisfactorily accounted for their appearance, and we might also say for their origin and their end, so far as questions of origin can come into the domain of science. It is now known that comets are not wanderers through the celestial spaces from star to star, but must always have belonged to our system. But their orbits are so very elongated that thousands, or even hundreds of thousands, of years are required for a revolution. Sometimes, however, a comet passing near to Jupiter is so fascinated by that planet that, in its vain attempts to follow it, it loses so much of its primitive velocity as to circulate around the sun in a period of a few years, and thus to become, apparently, a new member of our system. If the orbit of such a comet, or in fact of any comet, chances to intersect that of the earth, the latter in passing the point of intersection encounters minute particles which causes a meteoric shower. The great showers of November, which occur three times in a century and were well known in the years 1866–67, may be expected to reappear about 1900, after the passage of a comet which, since 1866, has been visiting the confines of our system, and is expected to return about two years hence.

But all this does not tell us much about the nature and make-up of a comet. Does it consist of nothing but isolated particles, or is there a solid nucleus, the attraction of which tends to keep the mass together? No one yet knows. The spectroscope, if we interpret its indications in the usual way, tells us that a comet is simply a mass of hydro-carbon vapor, shining by its own light. But there must be something wrong in this interpretation. That the light is reflected sunlight seems to follow necessarily from the increased brilliancy of the comet as it approaches the sun and its disappearance as it passes away.

Great attention has recently been bestowed upon the physical constitution of the planets and the changes which the surfaces of those bodies may undergo. In this department of research we must feel gratified by the energy of our countrymen who have entered upon it. Should I seek to even mention all the results thus made known, I might be stepping on dangerous ground, as many questions are still unsettled. While every astronomer has entertained the highest admiration for the energy and enthusiasm shown by Mr. Percival

Lowell in founding an observatory in regions where the planets can be studied under the most favorable conditions, they cannot lose sight of the fact that the ablest and most experienced observers are liable to error when they attempt to delineate the features of a body 50 or 100 million miles away through such a disturbing medium as our atmosphere. Even on such a subject as the canals of Mars doubts may still well be felt. That certain markings to which Schiaperelli gave the name of canals exist, few will question. But it may be questioned whether these markings are the fine sharp uniform lines found on Schiaparelli's map and delineated in Mr. Lowell's beautiful book. It is certainly curious that Barnard at Mount Hamilton, with the most powerful instrument and under the most favorable circumstances, does not see these markings as canals.

I can only mention among the problems of the spectroscope the elegant and remarkable solution of the mystery surrounding the rings of Saturn, which has been effected by Keeler at Allegheny. That these rings could not be solid has long been a conclusion of the laws of mechanics, but Keeler was the first to show that they must consist of separate particles, because the inner portions revolve more rapidly than the outer. The question of the atmosphere of Mars has also received an important advance by the work of Campbell at Mount Hamilton. Although it is not proved that Mars has no atmosphere, for the existence of some atmosphere can scarcely be doubted, yet the Mt. Hamilton astronomer seems to have shown, with great conclusiveness, that it is so rare as not to produce any sensible absorption of the solar rays.

I have left an important subject for the close. It belongs entirely to the older astronomy, and it is one with which I am glad to say this observatory is expected to especially concern itself. I refer to the question of the variation of latitudes, that singular phenomenon scarcely suspected ten years ago, but brought out by observations in Germany during the past eight years, and reduced to law with such brilliant success by our own Chandler. The north pole is not a fixed point on the earth's surface, but moves around in rather an irregular way. True, the motion is small; a circle of sixty feet in diameter will include the pole in its widest range. This is a very small matter so far as the interests of daily life are concerned. But it is very important to the astronomer. It is not simply a motion of the pole of the earth, but a wabbling of the solid earth itself. No one knows what conclusions of importance to our race may yet follow from a study of the stupendous forces necessary to produce even this slight motion.

The director of this new observatory has already distinguished himself in the delicate and difficult work of investigating this motion, and I am glad to know that he is continuing the work here with one of the finest instruments ever used in it, a splendid product of American mechanical genius. I can assure you that astronomers the world over will look with the greatest interest for Professor Doolittle's success in the arduous task he has undertaken.

There is one question connected with these studies of the universe on which I have not touched, and which is, nevertheless, of transcendent interest. What sort of life, spiritual and intellectual, exists in distant worlds? We cannot for a moment suppose that our own little planet is the only one throughout the whole universe on which may be found the fruits of civilization, warm firesides, friendship, the desire to penetrate the mysteries of creation. And yet, this question is not to-day a problem of astronomy, nor can we see any prospect that it ever will be, for the simple reason that science affords us no hope of

an answer to any question that we may send through the fathomless abyss. When the spectroscope was in its infancy it was suggested that possibly some difference might be found in the rays reflected from living matter, especially from vegetation, that might enable us to distinguish them from rays reflected by matter not endowed with life. But this hope has not been realized, nor does it seem possible to realize it. The astronomer cannot afford to waste his energies on hopeless speculation about matters of which he cannot learn anything, and he therefore leaves this question of the plurality of worlds to others who are as competent to discuss it as he is. All he can tell the world is:

> He who through vast immensity can pierce,
> See worlds on worlds compose one universe;
> Observe how system into system runs,
> What other planets circle other suns,
> What varied being peoples every star,
> May tell why Heaven has made us as we are.

SIMON NEWCOMB.

WASHINGTON, D. C.

THE RECENT VISIT OF SIR ARCHIBALD GEIKIE.

AMERICAN geology has been greatly benefited and stimulated by visits from distinguished European scientists, since the early part of the present century. All will recall at once Bakewell's observations on the recession of Niagara; Lyell's two visits, with the four volumes of 'Travels in America' that resulted, and that helped so much to establish a good correlation between many of our formations and those of Europe; von Richthofen's four years on the Pacific coast, and Credner's four years in the East; Posepny's travels in our mining districts; vom Rath's visits to mineral localities, and Geikie's excursions across the lava fields of the Snake River country. After an interval of eighteen years, the honor of again entertaining the distinguished Director of the British Geological Survey has fallen to American geologists, and has proved to be an occasion of exceptional interest and importance.

Some months ago Sir Archibald was invited by the authorities at the Johns Hopkins University to come to Baltimore and open the course of lectures in geology, made possible by a foundation established by Mrs. George Huntington Williams, in memory of her husband, the late, greatly lamented professor at Johns Hopkins. The purpose of the foundation is to support an annual course of lectures in geology which are to be given alternately by European and American geologists of distinction. No more fitting choice for the first series could have been made than that of Sir Archibald Geikie, to whose cosmopolitan sympathies, as shown in his 'textbook,' geologists everywhere owe so great a debt.

Sir Archibald reached New York April 17th, and on April 19th was given a reception by the New York Academy of Sciences, as described in an earlier page of SCIENCE (p. 702). Geologists from many institutions outside of New York united with the members of the Academy to make the welcome a cordial and significant one.

On Wednesday, April 21st, Sir Archibald began, at the Johns Hopkins University, the course of lectures which was the main object of his visit. The subject chosen was 'The Founders of Geology,' and in his treatment of the theme the lecturer sketched the rise of geological conceptions among the ancient cosmogonists, tracing their gradual though slow evolution through the middle ages, and their vigorous development at the opening of the present century. Exhaustive studies have been made by Sir Archibald upon these special subjects, and much new light has been thrown by them upon the true relations of modern systems of thought to the work of the pioneers in this field a hundred years and less ago. The lectures will ultimately be published, and space is

not available at this time to review them, but they cannot fail to be of great significance to all thoughtful students of the problems before us to-day.

Previously to the delivery of the lectures invitations had been sent by the Johns Hopkins University to geologists throughout the country, asking them to be present and to share in the excursions that were incident to the occasion. In response, the fifty or more whose names appear below accepted. While the lectures were being delivered short excursions were conducted almost daily to places of geological interest near Baltimore, on one of which Sir Archibald and his companions were the guests of the Secretary of the Navy at the Naval Academy, Annapolis, and upon one of the United States government vessels on a trip to view the Cretaceous and Tertiary formations along the Severn River.

A longer excursion was made at the close of the lecture so as to illustrate the geology of the State of Maryland from the later formations of the Coastal Plain, across the Archean axis of the Blue Ridge, and the Paleozoics as far as the upper Coal Measures in the St. George's field. Through the vigorous and untiring efforts of Professor W. B. Clark, who is also State Geologist of Maryland, the interest of the Governor of the State and of the principal railway and mining officials had been secured, so that free transportation was given on the Baltimoré and Ohio, the Cumberland and Potomac, and the Western Maryland Railways, as well as on one of the State official steamboats. On Wednesday, April 28th, the State vessel 'Governor McLane' carried a party of forty down Chesapeake Bay to view the Cretaceous and Tertiary strata in the bluffs along the shore. That evening two sleepers were boarded and reinforced by about ten additional guests from Washington; the party was taken to Cumberland, Md., from which starting point the members visited the St. George's coal field, as guests of President Lord, of the Consolidation Coal Company. Thursday evening Governor Lowndes, of Maryland, entertained the party at a reception in Cumberland. Friday was passed among the Cambrian, Silurian, Devonian and Triassic exposures along the Potomac River, and Saturday the President of the Western Maryland Railroad guided the visitors over the Blue Ridge mountains, where the Cambrian quartzite and pre-Cambrian volcanics are so well exposed. The trips closed with a visit to the battle-field at Gettysburg. It has left a lively feeling of appreciation in the minds of all the participants toward their generous entertainers, and especially toward Professor Clark and his associates at Johns Hopkins, whose efforts both before and during the trip were unstintedly given. The following list of participants in the excursions will indicate the very general desire on the part of American geologists to do honor to the distinguished guest:

F. D. Adams, McGill College, Montreal; Cleveland Abbe, Jr., of Washington; R. M. Bagg, Johns Hopkins University; W. S. Bayley, Colby University; F. Bascom, Bryn Mawr College; George F. Becker, U. S. Geological Survey; L. A. Bauer, University of Cincinnati; J. M. Clarke, Assistant State Geologist of New York; Samuel Calvin, State Geologist of Iowa; W. B. Clark, State Geologist of Maryland; N. H. Darton, U. S. Geological Survey; J. S. Diller, U. S. Geological Survey; C. W. Dorsey, U. S. Department of Agriculture; S. F. Emmons, U. S. Geological Survey; O. L. Fassig, U. S. Weather Bureau; Sir Archibald Geikie; D. C. Gilman, Johns Hopkins University: L. C. Glenn, North Carolina; R. T. Hill, U. S. Geological Survey; A. B. Hoen, of Baltimore; J. A. Holmes, State Geologist of North Carolina; C. W. Hayes, U. S. Geological Survey; J.

C. Hartzell, South Carolina; T. C. Hopkins, Pennsylvania State College; E. V. d'Invilliers, State Geologist of Pennsylvania; Lyman C. Josephs, of Newport, R. I.; Arthur Keith, U. S. Geological Survey; J. F. Kemp, Columbia University; E. P. King, Portland, Maine; Elizabeth Kirkbride, Bryn Mawr College; E. C. E. Lord, U. S. Geological Survey; F. J. H. Merrill, State Museum, Albany; W J McGee, U. S. Bureau of Ethnology; S. W. McCalley, Assistant State Geologist of Georgia; E. B. Matthews, Johns Hopkins University; J. A. Mitchell, Mt. St. Mary's College, Maryland; F. H. Newell, U. S. Geological Survey; W. H. Niles, Massachusetts Institute of Technology; Edw. Orton, State Geologist of Ohio; C. C. O'Harra, Carthage College, Illinois; Major J. W. Powell, Bureau of American Ethnology; L. V. Pirsson, Yale University; F. B. Peck, Lafayette College; Heinrich Ries, Columbia University; Harry Fielding Ried, Johns Hopkins University; R. D. Salisbury, University of Chicago; A. C. Spencer, U. S. Geological Survey; T. W. Stanton, U. S. Geological Survey; G. O. Smith, U. S. Geological Survey; G. W. Stose, U. S. Geological Survey; J. Stanley-Brown, of Washington; G. B. Shattuck, Johns Hopkins University; Chas. R. Van Hise, University of Wisconsin; C. D. Walcott, U. S. Geological Survey; Lester F. Ward, U. S. Geological Survey; T. G. White, Columbia University; I. C. White, Morgantown, W. Va.; H. S. Williams, Yale University; Bailey Willis, U. S. Geological Survey.

As the party was about to disband the following letter was drawn up:

TO THE BOARD OF COMMISSIONERS OF THE MARYLAND GEOLOGICAL SURVEY AND THE STATE GEOLOGIST:

Gentlemen: We have spent the last four days in a most interesting inspection of Maryland's geology, under conditions which your hospitable forethought has made peculiarly favorable. Our appreciation of the provisions made for the comfort of the party is keen, and our enjoyment of the excursion has been all that you could have wished it. In twice traversing the State of Maryland, opportunity has been afforded us of observing its mineral wealth, and in coming in contact with a wide range of phenomena illustrative of many of the aspects of geology. The field is rich, and it affords opportunities for inquiries which may add honor and wealth to the Commonwealth, contributing at the same time to the sum of human knowledge. The exploitation of these opportunities will be safe under your guidance, and we wish you a speedy success.

The paper was signed by Sir Archibald Geikie and the entire company of geologists.

At the close of the Baltimore visit, Sir Archibald went, on May 3d, to Washington, where, May 5th, he addressed the Geological Society of Washington upon the subject, 'Notes for a correlation between the Tertiary Volcanic Succession in Northwestern Europe and in Western America.' At the close of the lecture he was tendered a reception at the rooms of the U. S. Geological Survey. May 6th Sir Archibald visited Bryn Mawr College and briefly addressed the students, and May 7th lectured before the Philosophical Society in Philadelphia upon 'Recent Geological Work in the Hebrides and Faroe Isles,' after which the Society entertained him at a conversazione, at which many visiting geologists were present. May 8th he reached New York, and, aside from courtesies privately extended, was occupied with the rich collections of the American Museum of Natural History. May 10th he lectured in Brooklyn on the 'Geology of the Inner Hebrides,' and passed the remainder of the week in visiting Yale University and relatives in Connecticut. Saturday, May 15th, he sailed for England, accompanied by a cordial 'bon voyage' and an 'auf wiedersehen' from his many friends in America.

J. F. KEMP.

COLUMBIA UNIVERSITY.

NOTES FOR A COMPARISON BETWEEN THE TERTIARY VOLCANIC SUCCESSION IN NORTHWESTERN EUROPE AND IN WESTERN AMERICA.*

After alluding to the remarkably complete record of volcanic action in Britain, the lecturer proceeded to describe the most extensive and best preserved of all the volcanic series which is referable to Tertiary time and is remarkably developed from the south of Antrim through the inner Hebrides and Faroë islands to Iceland and Greenland. A general sequence has been noticed in the character of the erupted material. The earliest lavas appear to have been basalts, followed by andesites and, lastly, dacites. The basalts form extensive plateaus, each of which is built up of nearly horizontal sheets. The intrusive rocks included gabbros, ranging into peridotites and other basic materials, granophyres, granites, rhyolites and other acid rocks; the latest intrusions of all returning to the original basaltic type.

The earliest chapter in the Tertiary volcanic history of northwestern Europe brings before us the gradual building up of extensive plateaus of basalt which, in some places, reach a thickness of more than three thousand five hundred feet. These vast outflows of lava appear to have issued chiefly from fissures, like those of Iceland, but with occasional vents, some of which built up cones like those on the surface of the Tertiary lava fields of western America.

The general characters of the Scottish basaltic plateaus were illustrated by a series of lantern slides, and some examples were also given of Icelandic fissures, particularly of the great fissure which supplied the vast lava floods of 1783.

From the great antiquity of these Tertiary lava plateaus they have undergone extensive denudation and dissection, so that their structure is laid bare along many miles of picturesque coast line as well as on the mountain ranges of the interior. Examples of the results of subaëreal waste were displayed on the screen.

Continuing, the lecturer said that when the basalts had accumulated to a great thickness the magma appears to have found easier passage between the strata at the bottom of the volcanic series than upward through fissures; consequently, sheets or sills are found intercalated among the Jurassic rocks which form the base on which the volcanic series rests, while the lower portions of that series have been similarly invaded.

The next epoch in the volcanic history reveals to us the uprise of an infinite number of successive intrusions of basic material in sills, dikes and laccoliths at certain points in the midst of the basalt plateaus. On the whole, these masses consist of gabbros and dolerites, but they included also some beautiful examples of peridotites. There is no evidence that any of these intrusions reached the surface and appeared there in the form of lavas. They seem to have risen by preference at certain points of weakness, such as groups of vents. Examples of the relation between the gabbros and vents of different sizes are particularly observable in the islands of Skye and Mull.

Illustrations of the scenery of the gabbro bosses were shown by means of slides, together with a portion of the crest of the Cuillin Hills, to show the intricate manner in which the material had been injected. There was probably a long interval after the cessation of the gabbro intrusions. When the volcanic energy resumed its activity the composition of the underlying magma had completely changed. Rocks of a thoroughly acid character were now intruded. They took the form of bosses, sills and dikes, but there is no

*Abstract of a lecture by Sir Archibald Geikie given before the Geological Society of Washington on May 5th.

proof in any case that they flowed out at the surface as lavas. Like the gabbros, they were developed in special centers and preferentially in the areas already chosen by the gabbros; hence, the black, rugged mountains of gabbro are very generally accompanied by more or less regularly formed cones of granite and granophyre. These two cones not only form a striking contrast to the gabbros as regards their contour, but also in their colors. They range through various tints of yellow and russet. The characteristic scenery of central Skye, with the dark, rugged outlines of the gabbros on the west and the smooth, pale cones of the Red Hills on the east, depends upon this difference of geologic structure.

The latest phase in the volcanic history is marked by the uprise of another great series of basic dikes which, like those of the earlier time, follow a generally northwesterly direction and rise even through the latest masses of granophyre. On the flanks of the Red Hills of Skye long, dark ribs of rock may occasionally be seen even from a distance, which mark the last efforts of the Tertiary volcanoes of Britain.

W. F. MORSELL.

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*SOME PHASES OF WEED EVOLUTION.**

THE common statement that "a weed is a plant out of place" is by no means satisfactory or final to the student. He is still left to ask how it is that certain species have such pronounced ability for getting out of place. Almost any plant may accidently get where it is not wanted, but comparatively few usually and persistently get in the way. A bad weed species is aggressive and persistent. What qualities make it so?

As a partial answer I would suggest four life attributes as follows: 1. Great reproductive power. 2. Good provision for dissemination. 3. Various protective expedients. 4. Variability.

The statement that a species, to rank as a bad weed, should have large reproductive power needs no elucidation. It is not even necessary to demonstrate that weed species are thus equipped. Dozens of striking examples will occur at first thought.* We should also remember that many of the worst weeds have a double resource for their multiplication; *i. e.*, they propagate themselves by buds as well as by abundant seeds. The Hawkweed throws out stolons; and a Canada Thistle chopped into 20 pieces by the hoe becomes 20 Canada Thistles.

It is also axiomatic that facility of dissemination is one of the qualities of a weed species.

Some weeds make headway by means of special contrivances for avoiding disaster. Certain ones can withstand hard drought. Others have such deep roots as to be beyond the reach of ordinary cultivation. The Dandelion, often cut down by the lawn mower, bears its feathery tuft of seeds on a stem so short as to escape the gardener.

But variability is the chief and most significant quality of a weed species. Moreover, variability is ultimate. And those characteristics already mentioned are all involved in variability; for each one—reproduction, dissemination, protection—may vary, and through selection be indefinitely modified. In this sense, however, variability is not coordinate with the other qualities mentioned.

Other things being equal, then, that species which is most variable is apt to become a weed. This point may be illustrated, though perhaps not demonstrated by reference to some statistics of weed floras. Thus, starting with the proposition that variability is roughly proportional to the number of members in a systematic group,

*Notes from a lecture before the University of Vermont Botanical Club.

*cf. Kerner, 'The Natural History of Plants,' II., 878.

our hypotheses would lead us to the inference that the larger groups would show comparatively large quotas of weed species. Is the inference true?

Professor G. H. Perkins' Flora of Vermont enumerates 114 families of Phænogams and Pteridophytes in the State. Thus if the species were equally divided among all the families each family would include .87 per cent. of the total flora. The great family of Composites, however, contains 10.33 per cent. of all the species in the State. Now, if it contained its fair proportion of weeds it would have about the same percentage. The fact is, it contains 21.43 per cent. of all the weeds and 33.33 per cent. of all the very bad weeds. This family, at any rate, bears out the theory.

These figures with some others appear in the following table:

SOME VERMONT WEED SPECIES.

Family.	Per cent. of total Flora.	Per cent. of total Weeds.	Per cent. of bad Weeds.
Cruciferæ	3.00	6.25	16.67
Leguminosæ	3.33	4.47	5.55
Rosaceæ	4.58	4.47	5.55
Compositæ	10.33	21.43	33.33
Gramineæ	9.42	8.93	11.11
5 Families (5×.87 =4.35 %	30.66	45.55	72.21

That is, these five great families include nearly one-third the Vermont flora, but nearly one-half the weed species and nearly three-fourths the very bad weeds.

Of course, this does not demonstrate the proposition and there are perplexing exceptions. Thus the largest family in the Vermont flora, the Sedge family, contains not a single species which could be reckoned among the weeds. Nevertheless the family is eminent both as to variability and potential weediness. The sedges crowd out pretty much everything else on their own ground, and it is only because the agriculturist seldom enters their favorite territory that their pernicious possibilities do not become realities.

Attention may also be directed to the fact that many bad weeds have escaped from cultivation. Since cultivation usually induces variability, we may suspect that this has been one source of aggressive power in some weed species.

Dr. Asa Gray* pointed out that both our introduced and our native weeds are, to a very great extent, cross-fertilized. This is the more striking taken in connection with the accompanying statement that most of them are, nevertheless, capable of self-fecundation. The latter capability protects them from extinction when cross-pollination is impossible, and the former provision gives rise to effective variability when other plants of proper relationship are near.

Another surprising fact in the natural history of our weeds is the very large proportion of species introduced from Europe. In a list of the twenty worst weeds of New Jersey, prepared by vote, under the direction of Dr. Halsted, there were elected to the twenty highest degrees of noxiousness four natives and sixteen foreigners. I have examined a similarly-prepared list of the eighteen worst weeds of Vermont. This included four indigenous species and fourteen foreigners.

Such a plain fact as this ought to have some intelligible explanation. Dr. Gray, in his paper mentioned, sets down a common reason, namely, that, since the greater part of the Eastern States was originally tree-clad, the native species were such as thrive under forest protection. They are, therefore, unable to make their way in the cleared fields against immigrant species which have been inured to such conditions by centuries of thrifty practice in the open fields of Europe.

But a stranger fact of weed history exists

* *Am. Jour. Sc. and Arts*, 3d Ser., XVIII. (1879), 161. Reprinted in 'Scientific Papers of Asa Gray.'

in the number of species, of which there are several, which have come from Europe with comparatively clean passports to become aggressive and troublesome in America. This is the case with the Hawkweed (*Hieracium aurantiacum*, Linn.), which is just coming into prominence in some parts of Canada and the Northeastern States.* There are two reasons for this: First, the comparatively very rapid changes, which practically all America has undergone, have largely destroyed the natural equilibrium of species, and this has made it easier for capable weeds to creep in. Second, the principle pointed out long ago by Darwin as 'the good derived from slight changes in the conditions of life,' applies to the case of plants imported from Europe. This 'good' accrues to the species through induced variability.

Even more interesting points of inquiry are revealed when we turn to study the migrations of weeds within the United States. Merely as a suggestion for further work, I have made a few comparisons between Eastern weed floras and that of Kansas. Professor A. S. Hitchcock † enumerates 209 species of Kansas weeds, of which only 51 are foreigners against 158 natives. Even then nearly all the foreign species are specifically stated to be rare in the State. In my own list of the 20 worst weeds of Kansas, instead of the remarkable proportion of foreign species noted in Vermont and New Jersey, there are 6 foreign and 14 native species. It is also interesting to note that exactly half this list is made up of native composites. Of course, we may expect that, as commerce goes on between Kansas and the Atlantic States, the proportion of foreign weeds westward will increase; but we may feel confident that the Daisy, the Hawkweed, and the Kales will find no such easy time making headway against the sunflowers and ragweeds of Kansas as they have had against the modest, shade-loving species of the Eastern States. The native species of Kansas have been used to live in the open country, exposed to fire and drought and browsing herds of buffalo. Now when they find a well plowed field, with perhaps a little irrigation, they are fully prepared to occupy the ground and hold their own against the world.

Then there is the question of these Western species coming east. Sixty-five years ago *Rudbeckia hirta* was unknown east of the Alleghenies, yet now it is widely distributed in the Eastern States. *Coreopsis tinctoria*, Nutt., is a Western Composite and a bad weed, now much cultivated in gardens in America and Europe. From these it has already shown a tendency to escape, and may be counted as a coming weed. *Dysodia chrysanthemoides*, Lag., is said to be coming rapidly eastward. *Artemesia biennis*, Willd., also belongs to this list, and has recently been collected in the railroad and dock yards at Burlington, Vermont. This list might be greatly extended.

It seems probable that the great and variable and geologically modern family Compositæ is destined to play an increasingly important part in the future transformations of American weed floras, and that its representatives will be especially prominent among the successful native weed species, as, indeed, they already are in the weed floras of the Mississippi Valley States.

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*See Vermont Exp. Sta. Bull. 56 (1897).

†Kansas Exp. Sta., Bull. 57 (1896).

THE EFFECT OF THE DENSITY OF THE SURROUNDING GAS ON THE DISCHARGE OF ELECTRIFIED METALS BY X-RAYS.

IT has been found that the rate of discharge which occurs when X-rays strike upon a charged body is affected by the pressure of the gas surrounding such a

body. Certain contradictions concerning this variation which have been made by different experimenters indicated that it would be worth the trouble necessary to study this phenomenon with care. Perrin (C. R. 123, 351 and 878) states that the rate of discharge is proportional to the density, while Benoist and Hurmusezcu (C. R. 122, 926 and 123, 1265) state that the rate of discharge is proportional to the square root of the density. The only data given in any of these statements are those in one of the articles by Benoist and Hurmusezcu. They determined the rate of discharge by noting the time it took the leaves of an electroscope to fall from a given initial position to a given final position. The voltage to which the electroscope was charged is not given, but presumably it was large. The curve marked B. & H. in Fig. 1 gives the results of their experiments.

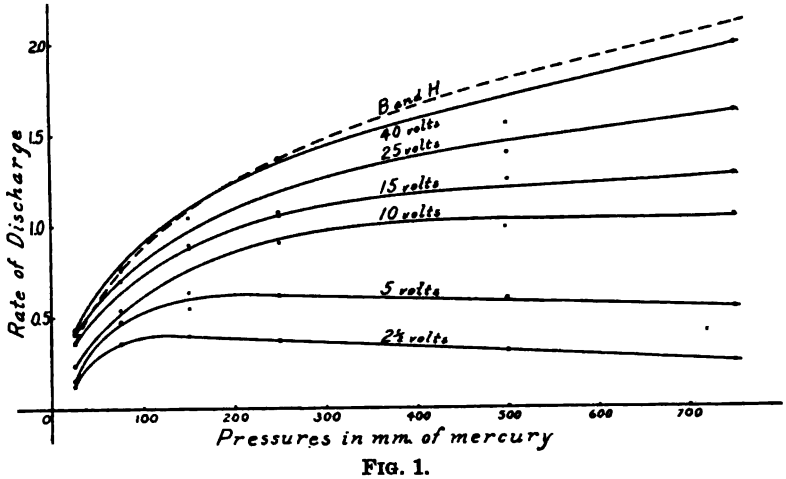

FIG. 1.

In experimenting along this line it was soon found that the curve given by plotting rates of discharge as ordinates and densities of air as abscissæ did not have the same form under all conditions, and while it may under certain conditions obey the law of Benoist and Hermusezcu, and may possibly under other conditions approximately obey that of Perrin, in general it does not obey either law.

The experimental work will be described more at length in the *Physical Review*, and only a brief account of the results are here indicated. My apparatus consisted primarily of a charged zinc plate and an electrometer. The plate was placed inside a box of the same metal from which it was insulated. The plate was connected to the electrometer and the box was ground, and both plate and box were placed in an air receiver which was connected to an air pump and a monometer. The rays struck the charged plate at nearly grazing incidence.

Care was taken to avoid ordinary electrical leakage and electro-static induction due to the action of the induction coil, also to protect the electrometer and its connections from the action of the X-rays, and from the action of the air through which the X-rays had passed.

The zinc plate had an area of about 50 qc.; the sides of the box were 2 cm. from the plate. The capacity of the plate, the connections and a small condenser placed in multiple with the plate was about 400 electrostatic units.

The rate of discharge was found by noting the fall in potential when the rays were allowed to strike the charged body for a few seconds, usually four, and also by noting the fall in potential when the zinc plate was connected through a very high resistance to a constant source of potential and the rays were allowed to strike the plate continuously. The high resistance was secured by winding two wires about each other which were covered with cotton insulation. The resistance through the insulation was about 5,000 megohms. The results from these two methods were in as $2\frac{1}{2}$. The former obeys fairly well the law of Benoist and Hurmusezcu, that the rate of discharge is proportional to the square root of the density. This agreement is shown by plotting the rates of discharge as given by them. The curve thus found is practically the same as that for 40 volts. The curve for $2\frac{1}{2}$ volts obeys an entirely different law, having, in fact, a maximum for about 200 mm. pressure. This effect seems less improbable when we remember that the discharging effect for the ultra-violet reaches a maximum at about 200 mm.

It is known that a metal tends to assume a

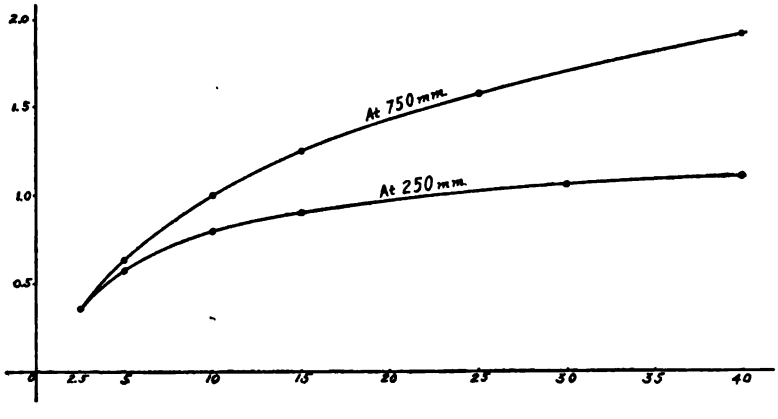

FIG. 2.

fully complete concordance as could be expected from the nature of the work.

That which had the most effect upon the relation between the rate of discharge and the density of the surrounding gas was the potential at which the discharge took place. Curves are given in Fig. 1 for the rates of discharge when the initial potentials were $2\frac{1}{2}$, 5, 10, etc., up to 40 volts. The ordinates indicate the number of volts that the charged plate fell per sec., and the abscissas indicate pressure in mm. of mercury. The difference in the essential character of these curves can be seen by comparing that for 40 volts with that for final potential different from zero when X-rays strike upon it. It was thought at first that this effect might be complicating the phenomena that were being studied, but care was taken that the plate from which the discharge took place was surrounded by a grounded plate of the same metal, and the final potential when the plate was disconnected from the source of the E. M. F. and the X-rays were allowed to strike upon it continuously varied so little from zero as to be entirely negligible.

It is evident that another set of curves could be plotted showing the relation between the rate of discharge and the E. M. F.

at different densities of the gas. Thomson and Rutherford (*Phil. Mag.*, 42, 392) and others have already studied this subject and shown that the current does not obey Ohm's law. As high E. M. F.'s are reached the current does not increase in a manner proportional to the increase in E. M. F. In Fig. 2 I have plotted such a set of curves, and it will be noticed that the form of the curve is not the same for different densities of the gas. Thomson and Rutherford have shown that the form of curve is not the same in the cases of air and hydrogen. The curve for air as given by them (Ibid, p. 404) is similar to the curve given in Fig. 2 for normal density of the air. That for hydrogen is similar to that given in Fig. 2 for pressure of 250 mm. However, it can scarcely be said that the form of the curve depends upon the density of the gas. The curve for mercury vapor as given by Thomson and Rutherford does, indeed, differ from that given for air in the opposite manner from that for hydrogen, but their curves for chlorine, sulphuretted hydrogen and air coincide in form, and the densities of these gases differ widely. They infer from their theory of this action "that more conducting particles are produced by the rays in air than in hydrogen, but that the product of U, the velocity of these particles, and T, a time which is proportional to the time these particles linger after the rays are cut off, is greater for hydrogen than it is for air." It is altogether possible that the same explanation may apply to the case where the same gas is used at different pressures. However, experiments to prove this would certainly be desirable. They also state that "the gases which have large saturation curves are those which contain the elements which have abnormally large specific inductive capacities in comparison with their valency." This remark does not seem to apply to the case where the same gas is used at different pressures. The saturation currents here do differ, and it is hard to see how either the specific inductive capacities or the valencies can differ for air at different densities.

It has also been found that the form of the curve between rates of discharge and density of air is different for different intensities of the rays. The curves which have already been plotted were taken with the tube near to the plate to be discharged. A series of curves were also taken with the tube at some distance from the plate and several inches of board placed between the two. These curves were somewhat similar to those shown in Fig. 1, but there was not as marked a difference between the curves for different potentials. In fact there was no curve which showed a maximum for pressures less than atmospheric pressure. It, therefore, seems scarcely advisable to try to get the form of the curves with any great degree of accuracy at present, for the form depends upon the intensity of the rays and there is no way of determining this intensity in any standard unit. I can define the intensity no better than I have already defined it in stating the rate of discharge which it produces from a zinc plate of given area with an approximate guess at the number of units of capacity in the system of plate, condenser and connections.

It has been stated by Perrin (C. R. 124, 454) that the discharge effect can be separated into a surface effect between the gas and the charged metal, and a volume effect throughout the gas. It was, therefore, thought that covering the zinc plate with a thin film of paraffin might change the form of the curve when the density of the air is changed. This was tried and no such change was noticed. It has not been possible to keep the action of the tube exactly constant, and so one cannot be entirely sure of the correctness of the results, but if coating the zinc plate with paraffin causes any change in the form of the curve it is at least small.

The plate to be discharged was then placed in the shadow of an opaque obstacle, and rays allowed to strike only the air near the plate. The form of the curve was not different from that obtained when the rays were partially screened off from both the plate and the surrounding air. These two experiments do not corroborate the theory of Perrin as given above.

It is also to be noted that the conditions in this last experiment were similar to those under which Perrin worked when he found the relations between the rate of discharge and the density of the gas, but the results which I found did not agree with the law as given by him.

There is also a fact in connection with this work which is worthy of note, although it does not directly bear upon the experiments here described. After the discharge had taken place the plate would often appear to recharge to a very noticeable degree. The electrometer used was a 'dead beat' electrometer. The recharging seemed to be more noticeable when the original potential was small, and the intensity of the rays great. My apparatus is not well adapted to study this phenomenon, nor have I had the time to do so. I hope hereafter to give a better proof of the existence of this phenomenon than I can at present offer, and to study the conditions under which it occurs more fully.

The experiments which I have described indicate a conduction effect through the gas rather than a convection effect due to particles thrown off from the discharging plate, but it would seem scarcely advisable to attempt to form a theory to explain these phenomena until they have been studied more completely.

Since writing the preceding I have investigated more completely the dependence of the rate of discharge caused by X-rays upon the potential used at different pressures of the surrounding gas. I find that the limiting value of the current is sooner reached when the experiment is carried on at low pressures than it is at higher ones, and that the limiting values, called by Thomson and Rutherford saturation points, are roughly proportional to the square roots of the density of the gas.

Stoletow (*Journ. de Phys.* 9, 471) found that in the case of discharge caused by ultra-violet light the pressure of the gas at which a maximum effect occurred was proportional to the potential with which he was working. I have tested the discharge caused by the X-rays in this respect, and for this purpose I used much greater intensity of radiation than I had previously used. I found the pressure for maximum effect to be roughly proportional to potential of the charged plate. Also the intensity of the rays has a very great effect on the point of maximum effect. The greater the intensity the lower was this point.

I have also tried allowing the rays to strike the charged body at normal incidence, and the results were the same which I had previously found when the incidence was grazing.

C. D. CHILD.

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CURRENT NOTES ON PHYSIOGRAPHY.

CORNISH ON SAND DUNES.

MR. VAUGHAN CORNISH discusses the formation of sand-dunes (*London Geogr. Journ.*, IX., 1897, 278–309), and throws much light on their growth and movements. Basing his work on observation and experiment he discusses the effects of supply and texture of sand and of direction and strength of wind, and reaches satisfactory explanations of transverse, longitudinal and crescentic dunes (*barchanes* of Arabia, *medanos* of Peru), adding a suggestive hypothesis for the origin by wind-excava-

tion of the Arabian sand pits (*fulje*) of hoof-print form. Some of these described by Blunt are over 200 feet deep, revealing the hard floor on which the loose sand lies. The horns of the crescentic *medanos* point in the direction of wind motion, because, being lower than the middle, they travel forward faster, and thus run ahead of the larger mass. The extension of coast dunes in ridges transverse to the active winds is shown to depend more on the location of the sand supply (the beach) than on wind intention or 'sand tactics.' The longitudinal dunes of the Indian desert, parallel to the dominating wind, exhibit the more perfect mastery of the wind over the sand; they are best developed where the wind is strongest. Transverse dunes are compared to large ripples of sand and exhibit the relative mastery of the sand over the wind. The most effective way to check the encroachments of blown sands is to promote the growth of existing dunes by wattle fencing; thus the advance of individual dunes and the formation of new dunes to leeward are retarded.

PHILIPPSON ON GEOMORPHOLOGY.

DR. A. PHILIPPSON, of Bonn, has contributed a series of articles to Hettner's *Geographische Zeitschrift* (II., 1896, 512–527, 557–576, 626–639, 688–703), on the progress of the above subject, in which he recognizes two divisions: a dynamical chapter, concerned with the forces at work on the surface; and a systematic chapter, concerned with the classification of forms according to their characteristic features and their causes. Geological structure and stage of development (by which young, mature and old forms are distinguished) are not given prominent place. Attention is devoted chiefly to the processes by which form is determined; weathering, transportation by streams, snow, ice, and wind, and the action of the sea, are considered in some detail, with numerous references to special articles; geomorphogeny, rather than geomorphology, being the leading theme. For example, under transportation by gravity, the determining conditions of landslips are briefly stated, but entirely apart from the structures and the stages of development in which landslips are characteristic and with little attention to the forms that they assume. While rational from the point of view of process, such a method seems empirical from point of view of form and, as such, characteristic of the current German method of study.

THORODSSEN ON NORTHEAST ICELAND.

K. KEILHACK gives an abstract in Petermann's Mitteilungen (XLII.,1896, 269–275) of Thorodssen's observations in northeastern Iceland in 1895. The Jokulsa delta formerly had a larger population, but is now in part laid waste by the gravels of its aggrading distributaries. South of the delta flat lava floods of great area spread around cones of moderate height; the lavas are seen to rest on glaciated dolerite. Indeed, all northeast Iceland bears marks of glaciation where not covered by younger lava flows and ashes. Fissures are noted at various points. East of the Jokulsa delta the broken ground is dislocated on the fissures. Lava flows issue from some fissures, and small craters are built over them. West of the delta fissures were formed during the earthquake of January 25, 1885, with small displacement of adjacent land blocks. The younger lava and tuffs of this region, both pre- and post-glacial, continue southward to the Vatna Jokull, apparently occupying a depressed district between the older basalts to the east and west.

VOLCANIC PHENOMENA OF 1894.

E. RUDOLPH, of Strassburg, continues the annual report on volcanic phenomena, previously prepared by Knüttel (Tschermak's Min. u. Pet. Mitth., XVI., 1896, 365–464).

A special bibliography is given for each important volcanic district, followed by a brief summary of events, with frequent historical review. From an abundance of material the following may be noted: Falcon island in the Friendly (Tonga) islands (20° 20′ S. lat.; 175° 20′ W. long). was first noted as a shoal in 1867. In 1877 smoke was seen ascending from the sea surface over the shoal. In October, 1885, an island had been formed 3,700 meters long and 75 meters high. At this time a terrific eruption was in progress, enormous clouds of constantly changing form rising over the island; earthquakes were felt on the neighboring islands and thundering sounds were heard on the southernmost island of the Fiji group, 325 kilometers away. In 1886 the island was estimated as 2,600 meters long and 50 meters high; in 1887 the height was 90 meters. In 1889 the length and breath were 2,040 and 1,630 meters; the height was 47 meters. The adjacent sea bottom was 1,800 meters deep. The island consisted of ashes and has subsequently been greatly reduced by wave action. In 1892 its height was only eight meters, and its disappearance may be soon expected.

LIMESTONE RANGE OF THE KLONTHAL, SWITZERLAND.

DR. CARL BURCKHARDT, a pupil of Heim's, contributes the 35th number of the Beiträge zur Geologischen Karte der Schweiz (Monographie der Kreideketten zwischen Klönthal, Sihl und Linth; Bern, 1896, 205 p., maps and plates). It concerns a small district in which the structural features of successive eastward portions are, as it were, out of joint with each other; this being explained as the effect of a folding and shearing on north-south lines, oblique to another folding on roughly east-west lines. Most of the report is given to stratigraphy; the later pages treat *Oberflächengeologie*, but less thoroughly than could be wished. A more detailed analysis of drainage lines might serve to determine the relative date of the two systems of folding, which is left in doubt. A characteristic feature of the work is a number diagrammatic views, drawn from nature by the author in a style closely resembling that of his master.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

NOTES ON AMERICAN CERAMICS.

THE device of the potter's wheel was unknown in either North or South America. A substitute for it is described as still in use among the Araucanians of Chili. It is a convex dish which is moved backward and forward on a smooth stone. Revolving in it, the clay is moulded to a symmetrically circular form. (*Globus*, Feb. 20.)

A cylindrical mug, with a handle, quite like a German 'Bierseidel,' was manufactured by the ancient Araucanians, as the same authority tells us; and it is singular how exactly this form recurs in the pottery of the Cliff-dwellers. Numerous examples are in the Museum of the University of Pennsylvania.

Intentional glazing was probably nowhere developed into a branch of ceramic art on this continent; but partially glazed specimens, of ancient date, are not unusual in Central American collections. Examples are in the Museum just mentioned. They seem to be accidental, owing to an abundance of siliceous matter in the clay.

THE RACIAL GEOGRAPHY OF EUROPE.

THE series of articles on this subject by Professor W. Z. Ripley, in the *Popular Science Monthly*, deserves the attention of all readers interested in questions of modern anthropology. The Europeans of to-day offer a peculiarly complicated problem, owing to the extensive crossings to which all

the types have been subjected. Professor Ripley undertakes its solution by an analysis of each of the ethnic elements, such as language, skull-form, complexion, hair, stature, etc. Numerous maps, diagrams, and photogravures put the reader at a glance in possession of the relative localization of these traits. The theories of their origin and distribution, as advanced by the principal students of the subject, are brought forward and examined. The author evidences both a thorough acquaintance with the subject and a freedom from bias in reaching his conclusions which cannot fail to command for them the most careful attention.

ANOTHER INTERPRETER OF THE MAYAN HIEROGLYPHS.

It is a gloomy duty to chronicle the victims to the story of the Mayan hieroglyphs, but a duty it is.

One of the latest is Herr A. Eichhorn, of Berlin. He has discovered that about 24,000 years ago the ancestors of the Mayas dwelt on an island in a now dried-up lake in Central Asia. They there developed a science of astronomy, mathematics and philosophy, which they embalmed in their heraldric insignia, their hieroglyphs and in the grammatic and etymologic construction of their languages. On reaching Central America, say about 12,000 B. C., they continued their relations with Europe until 1500 B. C., the Pelasgi and Leleges being really Mayas. About the ninth century of our era the Northmen visited Yucatan, and brought from there the Gothic style of architecture into Europe. Mayas, Nahuas and Toltecs are, in fact, the same people and speak the same secret language, as Mr. Eichhorn proves by an analysis of many words. Their common calendar system he explains with ease. It is entirely theosophic and symbolic.

Does the reader wish more? Then let him buy Mr. Eichhorn's work, a handsome quarto of 128 pages, entitled 'Naual, oder die hohe Wissenschaft der architectonischen und kunstlerischen Composition bei den Maya-Völkern.' (Berlin, Max Spielmeyer.)

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

A study of ozone from a technical standpoint by E. Andreoli appears in the *Journal of the Society of Chemical Industry*. Theoretically, one should be able to produce a kilo of ozone per electric horse-power, but in practice only ten or twelve grams are obtained. By improvements in the apparatus for producing ozone, the author increases the production to thirty and even fifty grams per horse-power, making the cost of ozone about three shillings a kilo. Among the improvements in the apparatus are passing the air directly between the electrodes, thus avoiding two glass dielectrics; a minimum distance between the electrodes, made possible by discarding the glass dielectrics; increase in surface (and number) of electrodes; use of electrodes covered with numerous sharp points. The author proposes a large number of technical applications of ozone, such as purification of drinking water, cleansing of beer casks, preparation of wood for instruments and furniture, bleaching of starch and dextrin, oxidation of drying oils, purification of wine and brandy, etc. It does not appear, however, that any of these proposed uses have been tested practically and on a large scale.

An investigation, by S. A. Andrée, of the amount of carbon dioxid in the atmosphere, abstracted in the *Chemisches Central-Blatt*, shows but slightly varying quantities at different elevations. Air collected on a balloon ascent from the height of 1,000 to 3,000 meters contained 3.23 parts carbon dioxid per 10,000; from 3,000 to 4,300

meters, 3.24 parts, while at the earth's surface the amount is 3.03 to 3.20. Nansen found, when crossing Greenland, that at elevations of 2,300–2,700 meters, and with a temperature of –20°, the amount of carbon dioxid was as great or even greater than at Stockholm. It seems now well settled that the old figure of 4 per 10,000 as the content of the atmosphere in carbon dioxid is decidedly too large, and that the amount varies locally within quite narrow limits, but with a tendency to increase slightly with the elevation. The cause of this variation is, as yet, unexplained, but the consumption of the gas near the surface of the earth by plants would seem to be a factor.

A SERIES of experiments on the resistance of cements to sea water was begun in 1856 at the harbor of La Rochelle, and is described in the *Thonindustrie-Zeitung* by E. Candlot. The experiments consisted in placing cubes of cement of different compositions, 60 centimeters long, where they would be covered by the sea at high tide and exposed to the air at low water. Blocks of cement without sand disintegrated more rapidly than those containing sand, and the best mixture was one volume of cement with from one to two volumes of sand. Such blocks lasted from twenty to thirty-eight years. This mixture corresponds to the least porous material, that is, the cement suffices to completely fill the interstices between the grains of sand. An excess of lime or magnesia in the cement is detrimental; this occurs when the quantity of silica and alumina is insufficient to saturate these bases. The best cement is that which requires least water for mixing, relative to the amount which it can hold chemically combined when 'set.' Portland cement was found to require very little excess of water, and hence gave the densest and least porous results and the maximum durability.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

A PERMANENT CENSUS BUREAU.

WE are glad to note that Senator Chandler, Chairman of the Committee on the Census, reported favorably, on May 10th, the bill providing for taking the twelfth census and for the establishment of a permanent census service. This bill was drawn up by the Hon. Carroll D. D. Wright, Commissioner of Labor, in accordance with a joint resolution of Congress, and demonstrates the advantages of securing expert scientific advice in regard to proposed legislation. The main provisions of the bill are as follows:

It provides for a permanent census office at Washington, the duties of which shall be the taking of the twelfth and succeeding decennial censuses and the collection of other statistical information in intervening years. The Director of the Census and the Assistant Director are to be Presidential appointees, but the latter must be an experienced practical statistician. The other officers, including five chief statisticians at an annual salary of $3,000 each, will be appointed under the civil service rules.

The sum of $75,000 is to be appropriated for the organization of the office. It is estimated that the annual cost will be less than $500,000, and that the decennial enumeration with the tabulation of results will cost an additional sum of about three or four million dollars. The permanent census bureau would consequently cost less than the eleventh census, for which some eleven and a half million dollars were expended. It is estimated by Mr. Wright that two million dollars of this sum can be charged directly to the fact that the force was not under civil service rules.

The bill provides for taking the census hereafter on April 15th in place of June 1st, as at the latter date the people are scattered from the cities. It is proposed to omit from the decennial census certain items regarding vital statistics, mortgages, Indians, etc., included in the eleventh census, these being in part relegated to other bureaus and to the separate States. The office would, however, issue annually accounts of agricultural products and biennially accounts of manufactures. Statistics of deaths and births would be obtained from the registration records

of the separate States and municipalities, supplemented by such data as the Director of the Census may think it advisable to secure. Statistics relating to the dependent, delinquent and defective classes would be published annually. It is hoped, further, to secure a quinquennial census of the population with the cooperation of the States.

ELIZABETH THOMPSON SCIENCE FUND.

THIS fund, which was established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, 'for the advancement and prosecution of scientific research in its broadest sense,' now amounts to $26,000. It is under the care of a board of trustees consisting of Henry P. Bowditch, President; William Minot, Jr., Treasurer; James M. Crafts, Edward C. Pickering and C. S. Minot, Secretary. As accumulated income will be available in November next, the trustees desire to receive application for appropriations in aid to scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance.

Application for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points: (1) Precise amount required. (2) Exact nature of the investigation proposed. (3) Conditions under which the research is to be prosecuted. (4) Manner in which the appropriation asked for is to be expended. The trustees are disinclined, for the present, to make any grant to meet ordinary expenses of living or to purchase instruments, such as are found commonly in laboratories. Decided preference will be given to applications for small amounts, and grants exceeding $300 will be made only under very exceptional circumstances. All applications should reach, before November 1, 1897, the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U. S. A.

GENERAL.

THE House of Representatives, on May 11th, by a vote of 100 to 39, refused to concur in the Senate Amendment to the Civil Service Sundry Bill, revoking President Cleveland's order regarding the forest reservations. Both the House and the Senate are evidently in favor of the inauguration of an adequate forestry policy, and we feel sure that suitable arrangements will be made.

MR. GALLINGER has reported favorably, from the Committee on the District of Columbia, the bill 'For the further prevention of cruelty to animals in the District of Columbia.' It is to be hoped that this bill, which proposes onerous and useless restrictions on the advancement of the medical sciences, will not be passed by Congress. All the representative bodies most competent to form an opinion on the matter regard the proposed law as useless and harmful. These bodies include The National Academy of Sciences, the American Association for the Advancement of Science, the Academy of Natural Sciences of Philadelphia, and many other societies more competent than the Senate to decide whether any cruelty to animals has been practiced in the District of Columbia.

BY the death of the Duc d'Aumale, on May 7th, the Institute of France comes into possession of the Château of Chantilly with its great collections, a bequest valued at $8,000,000.

PROFESSOR B. K. EMERSON, Professor O. C. Marsh, Professor S. F. Emmons, Mr. J. E. Spurr, Mr. A. H. Brooks, Professor W. H. Hobbs and Professor J. P. Iddings, all of the United States Geological Survey, will attend the coming International Geological Congress in Russia. They will be officially accredited to the Congress as representatives of the United States, the delegation to include also Professor G. P. Merrill, of the National Museum.

PRESIDENT DAVID STARR JORDAN, Mr. F. A. Lucas and Mr. Leonhard Stegneger will again this year act as commissioners to investigate the condition of the seals, and will leave for the Pribyloff Islands on or about the 1st of June.

THE Civil Service Commission announces a competitive examination to fill a vacancy in the

position of anthropologist in charge of the Division of Anthropology in the United States National Museum. The duties of the position will be the administration of the division of anthropology and the carrying forward of original investigation and study of the collections. The salary is $3,500 per annum. Competitors will be required to submit their answers to the inquiries and their essays on blanks furnished them by the Commission on or before June 1st.

AT a meeting of the Council of the Australasian Association for the Advancement of Science held at Sidney on March 25th it was decided that the commencement of the next annual session be fixed for January 6, 1898. It was decided further to suspend the rule requiring an initiation fee from new members. The Hon. Secretary, Professor A. Liversidge reported that he had written to the Premier quoting the amounts of pecuniary and other aids afforded in the past to the Association by the respective governments of Victoria, New Zealand, Queensland, Tasmania and South Australia, and asking for similar support from the mother colony. Professor Baldwin Spencer, of Melbourne University, will deliver a popular lecture at the meeting on 'The Center of Australia,' with special reference to its ethnological aspects.

A MEETING of the International Committee of Weights and Measures was held at Sèvres, near Paris, beginning on April 13th. Dr. Wilhelm Förster, Director of the Berlin Observatory, presided, and there were representatives present from Germany, Austria, England, Russia, Norway, Switzerland and Portugal.

AN International Congress for the unification of methods for the testing of materials will be held at Stockholm on the 23d, 24th and 26th of August of the present year.

THE Russian National Health Society proposes to celebrate, next year, the 100th anniversary of the discovery of the mineral springs of the Caucasus by a conference on balneology and climatology.

THE current number of *Nature* contains the thirtieth article in the series on 'Scientific Worthies.' The subject of the present article is the eminent Italian chemist, Professor Stanislao Carmizzaro. The text, by Dr. T. E. Thorpe, is accompanied by a fine portrait.

THE Paris Academy of Sciences has nominated as its first choice, M. le Colonel Bassot; as its second choice, M. Lippmann, for the position in the Bureau of Longitudes, vacant by the death of Fizeau.

THE Paris *Société de secours des amis des sciences*, a society whose object it is to assist poor scholars and their families, held its annual meeting on April 29th, under the presidency of M. Joseph Bertram, who made an address on 'The life of a scholar in the sixteenth century.'

THE New York State Forest Preserve Board, which has the important duty of buying $1,000,000 worth of Adirondack lands, held its first formal meeting on May 7th. Its members are Lieutenant-Governor Woodruff, State Engineer Adams and Forestry Commissioner Babcock. There were submitted to the Board offers of land in the Adirondacks amounting to over $1,000,000 in value, a large part of which is on the southern slope of the Adirondacks, the region where the Board thinks the larger part of the appropriation should be spent.

THE American Academy of Arts and Sciences, at its annual meeting on May 12th, elected the following officers for 1897–98:

President, Alexander Agassiz; Vice-President, Class I, John Trowbridge; Vice-President, Class II, George L. Goodale; Vice-President, Class III, Augustus Lowell; Corresponding Secretary, Samuel H. Scudder; Recording Secretary, William Watson; Treasurer, Eliot C. Clarke; Librarian, Henry W. Haynes; Councillors, Henry Mitchell, Leonard P. Kinnicutt, Edwin H. Hall, in Class I; Henry P. Bowditch, William W. Davis, B. L. Robinson, in Class II; Barrett Wendell, John E. Hudson, Edward Robinson, in Class III.

At the same meeting the following persons were elected Associate Fellows: In the Section of Medicine and Surgery, William Osler, of Baltimore, and William Henry Welch, of Baltimore, and in the Section of Literature and the Fine Arts, Horace Howard Furness, of Philadelphia, and Edmund Clarence Stedman, of New York.

THE National Education Association meets this summer at Milwaukee, from the 6th to the 9th of July, which will be convenient for those

wishing afterwards to attend the meeting of the American Association at Detroit.

At the annual meeting of the New York Electrical Society, on May 20th, Mr. H. Baringer Cox was announced to lecture on the Thermopile, with practical illustrations of certain novel features.

The valuable ornithological collection owned by the late D. von Homeyere has been purchased in part by Dr. W. Blasius for the Museum of Natural History at Brunswick, and in part by Dr. R. Blasius for his private use.

The Appalachian Mountain Club, of Boston, has arranged for an excursion to Amherst, Mass., on May 21st to June 2d, and to Dublin, N. H., from June 16th to 21st. The Club gave an 'At home' on May 19th, at which a collection of mountain pictures lent by Mr. Charles Pollock was on view, and other pictures were shown, including photographs of the mountains of the moon taken at the Paris Observatory, views of the Rockies and of the wonderful Muir Glacier.

We regret to record the death of Mr. Hugh Nevill, of the Ceylon civil service, who had discovered and described many new species in zoology and made valuable collections in ornithology and conchology.

The Directory of Scientific Societies of Washington, for 1897, prepared and published by the Joint Commission, Mr. J. Stanley-Brown, Acting Secretary, bears witness again to the dominant position of Washington as a scientific center. The number of members of the several societies is as follows: Anthropological, 138; Biological, 156; Chemical, 89; Entomological, 41; Geographic, 1,040; Geological, 144; Philosophical, 120; the total membership of the societies being 1,728 and the total number of persons 1,450.

D. Appleton & Co. announce, as a new volume in their 'Useful Story Series,' *The Story of Germ Life*, by Professor H. W. Conn.

Lord Lister presided at the annual dinner of the Royal Literary Fund on May 5th, and the speeches made by Lord Lister, the Bishop of Stepney, Mr. Traill, Mr. Lockyer and the Earl of Crewe were all concerned with the relations of science to literature.

Professor H. Moissan will lecture at the Royal Institution, London, on May 28th, on the 'Isolation of Fluorine.'

Replying to a question in the British House of Commons, Sir Mathew White Ridley said that the number of persons licensed to practice vivisection at the present time in England was 145, in Scotland 52, and in Wales 1; the number holding the certificate dispensing with anæsthetics was in England 86, in Scotland 30, and in Wales none. The only figures in his possession as regards Ireland were those for 1895; in that year the number of licenses was 6, of whom one held a certificate dispensing with anæsthetics. In giving the honorable member these figures he might remind him that the certificate in question was never given for operations involving serious pain, but only for such operations as inoculations or hypodermic injections.

Governor Black has signed the bill authorizing New York City to make an additional bond issue of $2,500,000 for the erection and equipment of four high schools.

Dr. Kolle, of the Berlin Institute for Infectious Diseases, has received a year's leave in order to proceed to Cape Colony, where he has been commissioned by the Cape government to continue the work on rinderpest and leprosy begun by Professor Koch.

A portrait of Lord Lister by Mr. Ouless is said to be among the best pictures at the recently opened exhibition of the Royal Academy.

Though an egg of the Great Auk was sold at auction recently for nearly $1,500, it is by no means the rarest of birds, being positively common in comparison with the Labrador Duck and Pallas' Cormorant, and the extraordinary value attached to its remains is somewhat singular. An instance of this was shown at a sale in 1895, where an egg of the Great Auk brought 180 guineas, while a well preserved egg of Æpyornis sold for 36 guineas.

Dr. W. F. Morsell writes that the suites of typical rocks of the Educational Series which the United States Geological Survey has been preparing for several years are ready for distribution; and the higher institutions of learning,

to which they will go, have been notified of the fact. There are nearly 200 sets, of 156 specimens each. The institutions are expected to pay for transportation, but are under no further expense.

AT the last meeting of the British Astronomical Association it was announced by the President (Mr. N. E. Green) that Miss Brown, the Director of the Solar Section of the Association, had presented £50 towards the expenses of erecting an observatory on the site offered by the Royal Botanical Society. Mr. J. G. Petrie, (Secretary), stated that the President had offered to commence the equipment of the observatory by presenting his 18-inch reflecting telescope, with which he had made many of his drawings, and that Mr. Calver had also offered optical aid.

ON Saturdays in June and July, when the Royal Botanic Gardens are opened to the public by payment of a fee, gardeners will be detailed to take visitors around the gardens to show the points of interest and describe the plants.

THE fifteenth anniversary of the Institution of Mechanical Engineers, London, was celebrated by a dinner on April 29th. Mr. E. Windsor Richard, the President, occupied the chair, and speeches were made by the Duke of Cambridge, Sir F. Bramwell, Professor Kennedy and others.

The Psychological Index, compiled by Dr. Howard C. Warren, of Princeton University, and Dr. Livingston Farrand, of Columbia University, and issued annually as a supplement to *The Psychological Review*, has been published for the year 1896. The bibliography of the literature of psychology and cognate subjects for that year extends to 145 pages and contains 2,234 titles. Psychology is one of the fifteen sciences to be included in the International Bibliography of Scientific Literature, but, while the plans for this great undertaking are being matured, *The Psychological Index* is essential to students of psychology and cognate subjects.

THE first two numbers of a *Zeitschrift für Criminal - Anthropologie, Gefängniswissenschaft und Prostitutionswesen*, edited by Dr. Walter Wenge and published by M. Priber, Berlin, have been issued. These numbers include articles by Dr. Näcke on 'Lombroso and Modern Criminal Anthropology,' by Professor Preyer on the 'Hand-Writing of Criminals,' by Dr. Penta on 'The Rational Treatment of Criminals,' by Dr. Paul on 'Identification,' and other articles on similar subjects, together with a review of the literature.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Governors of McGill University, in accordance with the custom of British and Canadian universities, announce that they are prepared to receive applications for the appointment to the chair of zoology recently founded by Sir Donald A. Smith. The annual salary is $2,500. Candidates should forward applications with testimonials before June 1st to Mr. W. Vaughan, Secretary, McGill University, Montreal.

IT is announced that the College of Physicians and Surgeons of Chicago will be affiliated with the University of Illinois.

BARNARD College, New York, has received a gift of $140,000 from Mrs. Josiah M. Fiske for a building to be called Fiske Hall in memory of her husband. This will enable the trustees to complete the new quadrangle, the other halls, provided by Mrs. Brinckerhoff and Mrs. Anderson, being now nearly ready for occupancy. Barnard College has also received $6,000 from Mrs. Henry O. Havemeyer for the equipment of the chemical laboratory and $2,000 from others for the furnishing of the Brinckerhoff Hall.

ROSSE Hall, Kenyon College, was burned May 9th. The loss is estimated at $10,000.

THE chair of mineralogy and metallurgy in Columbia University, vacant by the retirement of Professor Thomas Egleston, will be divided, Professor A. J. Moses being promoted to a professorhip of mineralogy, and Mr. H. M. Howe, a graduate of Harvard University and the Massachusetts Institute of Technology, being appointed professor of metallurgy.

THERE are 450 candidates for degrees this

year at Cornell University. Of these 136 are in the department of arts and sciences and 137 in the Sibley College of Mechanical Engineering. There are 18 candidates for the doctorate, 14 in philosophy and 4 in science.

THE will of the late Miss Brown, of Waterhaugh, Ayrshire, leaves £5,000 both to the University of Edinburgh and to the University of Glasgow.

THE Cambridge Syndidate appointed to consider the question of degrees for women have issued a second report, in which they state that after carefully considering the discussion of their first report they adhere to their recommendations. The statute recommended is as follows: "The University shall have power to grant, by diploma, titles of degrees in Arts, Law, Science, Letters and Music to women who, either before or after the confirmation of this statute, have fulfilled the conditions which shall be required of them for this purpose by the ordinances of the University, and also shall have power to grant by diploma the same titles *honoris causa* to women who have not fulfilled the usual conditions but have been recommended for such titles by the Council of the Senate; provided always that a title granted under this section shall not involve membership of the University."

DISCUSSION AND CORRESPONDENCE.

FORMER EXTENSION OF ICE IN GREENLAND.

I HAD not intended writing on this subject again, but Professor Chamberlin's criticism* of my paper in the Bulletin of the Geological Society of America calls for a reply. For the benefit of those, if there are any, who think that problems of Greenland glacial geology can be settled at long range, by a comparison of photographs, I wish to point out that Professor Chamberlin has selected for publication, not the view in my paper, which *does show* some ruggedness, but one inserted primarily to show glaciated topography. Therefore I can agree with some of Professor Chamberlin's remarks.

Had my critic sailed along this coast he would have seen the Devil's Thumb as a high peak with serrated sky line, precipitous front and numerous evidences of ruggedness. He would not have seen the well glaciated back, which my view shows, and would not have known that, while in all other places the peak is inaccessible, the ascent from the glaciated back was easy. Had he made this ascent he would have found even more distinct evidence of ruggedness and, throwing a stone as large as one's head, would have found that from five to seven seconds elapsed before it struck, indicating a nearly sheer precipice of perhaps 500 feet. Whether this would have been classed as angular and unsubdued I cannot, of course, say; but my classification of it, in the view obtained from the sea, is distinctly unsubdued. Some idea of the nature of this west face (or left side) may be gained from the photograph, though the cliff is three or four miles from the camera and the picture, as printed, far less distinct than the original view. Dozens of hills in this region have the same characteristics, including Fig. I., plate 27 (in my article), in which, however, glaciated topography is seen in the background on the right, which would not have been seen from sea-level.

I have nothing to say concerning my query about the 'driftless area,' which, judging from the warmth of the reply, seems to be resented. Nor do I feel called upon to defend my use of the term Devil's Thumb. From Professor Chamberlin's remarks one would infer, what is not the case, that I had made an error in placing names. Geologists would be undertaking a very serious task if they attempted to verify the maps they use. The Ryder map, from which the name is adopted, is based on an *official Danish Survey*, and for the region is quite remarkably accurate. Since this map is published in my paper, and a foot-note announces my belief that Ryder has made an error in naming the mountain the Devil's Thumb, no real confusion will arise in the minds of those who read my paper carefully and candidly.

Professor Chamberlin makes another mistake when he says that I insist 'upon general glaciation.' I have never done this, but have brought forward evidence which, I believe, proves the opposite conclusion to be a generalization based upon questionable field methods,

* SCIENCE, p. 748, and in a somewhat different form in *Journ. Geol.*, V., 1897, p. 303.

so that the work ought to be done over before the conclusion can be accepted.

Since Professor Chamberlin has again and again mistaken my position, or has otherwise changed the point at issue, and since little of scientific value is likely to come of this discussion, I shall write no more upon this point.

RALPH S. TARR,

CORNELL UNIVERSITY.

POUDRÉ.

TO THE EDITOR OF SCIENCE: Mr. Goode's description of what he calls *Pseudo-Aurora* (SCIENCE, January 29, 1897), as seen by him at Moorhead, Minn., is abundantly confirmed by my own observations at this place. The complete manifestation of the phenomena is comparatively rare. The finest I ever saw was on January 22, 1890, an account of which was furnished by me at that time to the *American Meteorological Journal*, and published in the February number, and to which the title of this article was given by the editor, Mr. M. W. Harrington. From this article I condense the following extract: After a ten days' period of continued cold weather the thermometer reaching — 20° to — 32° at night, a south wind set in on the 22d, and the temperature rose to +10°. During the afternoon and evening the air seemed full of small ice crystals; and my recollection is that I examined them, and found them to be, as Goode describes them, minute, thin, perfectly clear, hexagonal ice-crystals. The reflection of street lamps and electric lights made long streams of light, *all tending to the zenith of the observer;* that produced by the electric light being so nearly like the Aurora Borealis as readily to be mistaken for it.

LUDOVIC ESTES.

UNIVERSITY OF NORTH DAKOTA, April 28, 1897.

EARLIEST PUBLISHED NOTE OF THE LATE CHAS. E. BENDIRE.

IN my obituary of Major Bendire, published in SCIENCE of February 12, 1897 (pp. 261–262), I stated that "his earliest published writings are in the form of letters to well-known naturalists, chiefly Allen, Baird and Brewer." While this statement is correct as it stands, the first letters mentioned by me were published in 1876. Dr. Coues calls my attention to an earlier note I had overlooked, one by himself in the *American Naturalist* for June, 1872 (p. 370), in which a quotation is given from a letter about a small owl, written by Bendire, from Tucson, Arizona. So far as I am aware, this is the earliest publication of any of Bendire's notes.

C. H. M.

SCIENTIFIC LITERATURE.

RECENT TEXT-BOOKS IN PHYSICS.

Elementary Text-books on Physics. ANTHONY AND BRACKETT. Revised by W. F. MAGIE. John Wiley & Son. Eighth edition. 1897.

The Elements of Physics. NICHOLS AND FRANKLIN. Volume III., Light and Sound. The Macmillan Co. 1897.

The Outlines of Physics. E. L. NICHOLS. The Macmillan Company. 1897.

Problems and Questions in Physics. MATTHEWS AND SHEARER. The Macmillan Company. 1897.

Intermediate Course of Practical Physics. SCHUSTER AND SEES. The Macmillan Company. 1896.

Experimental Physics. W. A. STONE. Ginn & Company. 1897.

First Principles of Natural Philosophy. A. E. DOLBEAR. Ginn & Company. 1897.

In view of the enormous number of new books, on all sorts of subjects, which are continually making their appearance, it is important to inquire whether book-makers, publishers and authors are not increasing at an abnormal rate. Indeed, it begins to look as if some check on their activity would shortly be necessary for the protection of those old fashioned people whose pleasure it is to read rather than to write books. At the present rate of book production it will not be long before that day, which has often been foretold, is actually at hand when every man will have time to read only his own works, and even now there must be some authors who are too busy for that.

The intellectual, and especially the scientific, activity of the present period is in some measure finding an outlet in the preparation of text-books for schools and colleges, and this is particularly true in the domain of the physical sciences.

It is easy for a teacher to convince himself that there is no existing book quite suitable for his work, and the feeling that he can make one which will meet his own wants and those of many other teachers is entirely natural. The result is a continually increasing number of texts, which are multiplying so rapidly that before long every class will be using that of its teacher for the time being, and no more dreadful catastrophe could overtake the long-suffering body of students whose interests are often lost sight of by teachers ambitious to become authors.

Although a very general practice, it is by no means always a sound one, to insist upon a class using the texts prepared by its instructor, and this is true even when that text is one of the very best of its class. American students are often greatly benefited by the use of English text-books, and there are many American books used with profit in English schools. By using a text prepared by one able scholar and sitting under the instruction of another the student is doubly benefited, and the harm which comes from a multiplicity of texts would be greatly lessened if every author were forbidden to use his own book. It is quite true that under such conditions there would be many books never used at all, but this would be one of the principal advantages of the scheme.

The above remarks, while suggested by, are not considered as specially applicable to, the list of new books on Physics which they follow, all of which, and many more, have issued from the press within a very few months. It may safely be asserted that no other science has grown and developed during the past ten or fifteen years as has this, and this growth is reflected in the very large number of text-books and treatises of all grades which have made their appearance during the last few years. They are easily divided into three classes: those that possess real merit and originality of treatment and which could not be spared without serious loss; those that are good, at least not bad, and whose existence is harmless; and those that, for various reasons, are undesirable and unwelcome, because unsound in either matter or method or both. In physics teaching and text-books, as in every other department of education, there appears the fad and the 'faddist.' In these days everybody is running after something *new*, not something good or useful. To achieve reputation in educational circles it seems only necessary to exploit a novelty, but fortunately in science teaching a considerable restriction is put upon this tendency by the inflexibility of natural laws. Curiously enough, in the making of books on physics that which is really most difficult is generally thought to be the easiest and is, therefore, the more frequently attempted. In the preparation of an extensive treatise on the subject the all important feature is matter, method being of only secondary importance; while in a text-book method of presentation rises to an importance fully equal to that of a truthful presentation of the principles and facts of the science, especially as it includes the selection of just what principles and what facts shall be set forth. Yet, although few undertake the preparation of a treatise, many esteem themselves fit to make a text-book. A well written treatise will usually include essentially all that the author knows about the subject; a well prepared text-book will generally represent only a small part of his knowledge.

Unfortunately too many text-books in physics contain all their authors know and much more, but the latter-day willingness of really able scholars to prepare elementary texts will before long put an end to their popularity.

The list of books given above contains several that will do to 'tie to.' The well-known text of Anthony and Brackett, published first about ten years ago, has enjoyed extensive and deserved approval as a college text-book of physics, and in this, the eighth edition, it has undergone extensive revision and improvement at the hands of Professor Magie, of Princeton, who had much to do with its making in the beginning. The changes are most evident in the treatment of electricity and magnetism and in the discussion of mechanics and the Kinetic theory of matter, in which respects as well as along some other lines the book has been practically re-written. The methods of treatment and the conception of fundamentals have been modernized, and the new edition constitutes a distinct advance, although the general features

of the original plan are preserved. The book constitutes an excellent college course on physics when supplemented, as it is meant to be, by full experimental illustrations on the lecture table. It is in no sense a laboratory guide, nor does it imply the existence or use of a laboratory.

For the great majority of students such a book and such a course ought to be supplemented by the use of a collection of problems illustrating the various divisions of the subject, and which are quite necessary to fix its principles.

The *Problems and Questions in Physics*, by Matthews and Shearer, will fairly well satisfy the demand for such a collection. The selection and arrangement of problems is, on the whole, very satisfactory, but the authors seem to have been continually in doubt as to whether they were not, after all, making a 'text-book.' Certain subjects are discussed at greater or less length, although the same matter will be found in almost any standard text. Considerable cost and space might have been saved by adhering strictly to the plan of a book of problems, and, indeed, some of the discussions do not tend to clarify the subject in any degree. No student can go through this book, however, without being greatly benefited.

Similar in grade to and not differing materially in plan from the new edition of Anthony and Brackett is the *Elements of Physics*, by Nichols and Franklin, the third and last volume of which has just been issued. Light and Sound are the subjects considered, and the treatment is largely mathematical yet elementary. There are no problems or exercises, and the scheme assumes lecture-table illustrations and occasional expansions by the instructor supplemented by actual laboratory practice by the student. Those who are familiar with the earlier volumes of this series will not need to be told that the work is well done and that the publication of this volume completes a valuable addition to the growing list of available text-books for use in colleges and in engineering or technical schools.

Professor Nichols also offers, in the *Outlines of Physics*, a text-book for the use of high schools or academies, a thorough knowledge of which he hopes may be accepted in lieu of a year of more advanced mathematics now required for admission to some colleges. There are some serious objections to this plan, to which extended consideration cannot be given in this place, for they in no way concern the character of the book under consideration. Every question concerning the relation of the secondary school to the college has two very distinct sides, but looking at only one of them, namely, the college side of the question, it may seem hardly wise to exchange a preparation in mathematics, which is undoubtedly more perfectly accomplished than anything else in secondary schools to-day, for a course in physics, instruction in which is far from what it should be. Professor Nichols's book contains a good résumé of the principles of the science, and is intended to serve at once as a text-book and laboratory guide. There is much difference of opinion among teachers of physics as to the wisdom of such a combination, many holding that really substantial results in the laboratory are only obtainable *after* a course in a good text-book with lecture-table illustrations, and that encouraging the average student to do laboratory exercises from the start is like plucking fruit before it is ripe. The immediate result is unsatisfactory, and subsequent perfection is well-nigh impossible. To those who believe in the method, however, Professor Nichols's book ought to take rank as one of the best of its kind, and, on account of its sound exposition of fundamental principles, much ahead of many that have appeared within the last decade.

Very similar in general character is the *Intermediate Course of Practical Physics*, by Schuster and Lees, which comes to us from the laboratory of Owens College, Manchester, to which physicists are already indebted for a number of high-class text-books. This book is extremely well done and will be of interest and value to all concerned with elementary instruction in physics. It is more nearly a laboratory guide than is Nichols's Outlines and should be used in connection with a text book. It may be criticised for the rather coarse experimentation which is occasionally employed. The standard of the laboratory should always be high, as the value of the work to the student depends almost entirely upon the degree of refinement and

precision required in its execution No laboratory in which such a book is likely to be used can fail to do better in the way of a simple pendulum than 'a string and a leaden bullet;' and successive values for 'g' ought not to differ from each other by as much as one and a-half per cent.

Professor Dolbear's little book on the *First Principles of Natural Philosophy* might impress one as being, in text as well as title, a protest against the progress of physics during the past quarter of a century. It is true that there are some things in it that were not known twenty-five years ago, but not many. Throughout the volume the author makes no mention of the metric units of mass and length, on the use of which so much of modern physics depends, declaring himself very decidedly against them in his preface. This naturally results in much confusion and difficulty, especially in the matter of electrical measurements. The fundamental principles of dynamics are presented in a confused and uncertain manner, and accuracy is sacrificed often apparently to secure simplicity.

Mr. Stone's *Experimental Physics* is evidently the outcome of his desire to satisfy the demands of the Harvard College entrance examinations in physics. The well-known 'forty experiments' prescribed by the Harvard authorities are included with a considerable number besides. The author says that the book is the result of nearly ten years' experience in teaching experimental physics, but he gives no hint as to how many years he has spent in studying the subject. The latter query is suggested by the numerous evidences of ignorance, or of extremely careless writing, which are scattered through the book.

Without raising the question of the soundness of the method adopted, which is that of laboratory work from the start, and before the student knows the simplest elements of his subject, it is sufficient to note that if the experiments outlined are made with care and reasonable precision very many of them will entirely disprove the principles they are intended to establish; while, on the other hand, if many of the principles laid down are accepted without careful tests the student will acquire many quite erroneous notions regarding the properties of matter and the principles of physical science. This is a serious indictment, but in its support it is only necessary to refer to the assumption that the breaking weights of wires of the same material are proportional to their cross sections; the announcement of the 'law' that for a given tension the elongation is inversely proportional to the area of the cross section of the wire, and other things similar in character. If the author had actually experimented on these things, instead of trying to tell others about them, he would not make such utterly absurd statements. The book contains many excellent problems, and now and then a good suggestion as to experimental methods.

There are many books of this type, and they all enjoy a common distinction of being, on the whole, more likely to create a distaste for real work than an appreciation of, and a love for, the science of physics. The study of the subject is made largely mechanical by having every experiment explained in the utmost detail, so that the student has nothing to do but to put the various pieces that he finds, carefully placed upon his desk, in the several relations explained in the book, and then note the result which the book tells him will follow. Occasionally some unfortunate may note that the prescribed result does *not* follow, but that something else happens, and in good time he may become a physicist, if not too thoroughly instructed.

It ought never to be lost sight of that the *real* value of instruction in physics, and especially in experimental physics, lies in *teaching people to think*. As a means of accomplishing this it has, perhaps, no rival, but both in and out of books the shadow is too often mistaken for the substance.

Antropologia della Stirpe Camitica. By Giuseppe Sergi. Torino, Fratelli Bocca. 1897. 8vo. Illustrated. Pp. 426.

This well-printed volume is part of an extensive study of the anthropology of Africa, projected by the distinguished professor of the University of Rome. It is devoted to the divisions, characteristics and distribution of that branch of the human species which, following

older authorities, he continues to call 'Hamitic.' To him this is more than a branch; it is a separate species of the genus *Homo*, to which, adopting the adjective first proposed by the writer of this notice, he assigns the term, 'Eurafrican,' indicating that its branches are to be found in both Europe and Africa (though he modifies the connotation of the term to suit his peculiar views).

Professor Sergi is best known from his physical studies of man, but in this volume he assigns linguistics a prominent place. In his preface, however, he is certainly unfair to his predecessors in asserting that they have not followed the zoological methods in anthropology. The very plan he puts forward as new, and his own, is perfectly familiar to readers of Darwin and Haeckel, and it can scarcely be ignorance of their anthropologic writings which led him to insert such a statement. His position as a polygenist is, moreover, surely inconsistent with the zoological method, as there is not a single zoologically specific difference to be found between the races of men. Therefore, what he calls in his preface 'the new and unexpected fact' of the specific independence of the Hamitic stock (for such it only is—not even with pure racial peculiarities) will be regarded as new, indeed, but far from true.

Nor will his treatment of the purely physical traits meet general acceptance. Skull forms have become less and less criteria of racial classification, and on these he bases most of his distinctions. The interesting and ethnically important question as to the origin of the blond Libyans he treats in a most unsatisfactory manner. Basing his opinion on a few local observations in Italy (themselves to be explained historically), he makes the extraordinary assertion that we may expect blonds above an altitude of 401 metres, and that the brown Lybians turned blonds by residing above that height! (p. 296.)

While the work is marred by these and some other grave deficiencies, its general composition is highly commendable. He divides the Hamitic stock, as others have done, into two branches, an eastern and a northern (others prefer western, which is more correct). The former are the 'black Hamites,' as the Somali and the Galla. He includes in them the ancient Egyptians, the Ethiopians and the Abyssinians, in which he will be followed but slowly, though no doubt they all partook of Hamitic blood at an early date. He also attaches to this branch the warlike Massai and the Wahuma. His northern branch embraces the Libyans and Berbers (who are, in fact, ethnically one), the tribes of the Sahara, the Tuaregs, Tebu and Fulbi, and the extinct Guanches of the Canary Islands. In these he does not go beyond the schemes of earlier writers.

In his concluding chapter he intimates the extension of his 'Eurafrican species' into Europe, concerning which he proposes to publish another volume. The 'species' will include the ancient peoples of Spain, Italy and Greece, Syria and central Europe, but will exclude the Celts, Slaves, Lithuanians and some Germanic peoples (p. 395). They belong to a different species! Certainly this is a strange use of a zoological term!

The work is well illustrated and contains a sketch map of the geographic position of the Hamites. There is also an excellent index.

To those readers who are acquainted with Professor Sergi's essay on 'the Mediterranean Stock' most of the theories in the work before us will be familiar. But the numerous facts which he has collected bearing on the traits and extension of the Hamitic stock will be gratefully received.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

Elementary Human Physiology. By J. G. M'KENDRICK, M.D., F.R.S. W. and R. Chambers, London and Edinburgh. 1896. Small 8vo. Pp. 240, with 164 woodcuts.

This book is based on a small manual on Animal Physiology, written by the author twenty years ago. The chapters are said to have been almost wholly rewritten and 'rearranged to suit the syllabus of the First or Elementary Stage, issued by the Department of Science and Art.' Copies of the examination papers of the Science department, South Kensington, for 1890–95 are given in an appendix.

As to the book itself, it may be said that the reviewer took it up with regret, recalling favorably a larger work by Professor M'Kendrick,

which appeared several years ago. The first impression was that this smaller volume was written around a set of illustrations of respectable age, but for the most part still serviceable. More careful reading, however, makes it clear that we are dealing with a pretty good elementary presentation of the subject, and that our first impression was not altogether just. We are ourselves somewhat skeptical of the scientific value of physiology in the secondary schools. Everything depends here upon the excellence of the teacher, and a good one will find M'Kendrick's book useful. It is to be sure, quite uneven, and in some places there is more detail than can be taken in by the class of students which the author seems elsewhere to have in mind. Much of the discussion is given with evident care and discrimination, and the facts presented are in general, despite the necessary brevity, quite fully modernized; even argon and the hot and cold spots are not forgotten, and the problems of interstitial secretion are suggested. There are, to be sure, many points on which one may well differ with the author, but most of them are perhaps not such as to involve serious defects. It must be said that the account of the nerve cells is altogether inadequate. The picture of them (Fig. 140) is quite in opposition to our present views and will make a stronger impression, we fear, than the explanation which partially corrects them and also shows that Professor M'Kendrick is well aware what the prevailing view is. The description of voice production is unsatisfactory and requires fuller illustrations without which most young students must find Fig. 164 hard to understand.

Joseph W. Warren.
Bryn Mawr College.

The Story of a Piece of Coal—What it is, whence it comes and whither it goes. By Edward A. Martin, F.G.S. New York, D. Appleton & Co. With thirty-eight illustrations. 16mo. Pp. 168.

Mr. Martin's little book shows that the author has read widely, has selected judiciously and has told the story pleasantly. The narration is attractive, and is likely to be commended by the readers for whom it is intended.

All this makes one regret that the judicious selection was not associated with accurate reading. There are serious slips in too many places, and there is too much of positive assertion where modest suggestion would be preferable. As for some of his statements, it must be said that he should have every opportunity to prove them, since many persons would not accept them without hesitation.

Among other things, he tells us that iron, silver and water alone possess the power of expanding, when passing from the liquid to the solid state (p. 80); that no explosions in the anthracite region of Pennsylvania were due to coal dust (p. 100); that coke if properly made, should consist of pure carbon, and that good coal should yield as much as 80 per cent. of coke in the gas retort (p. 109); that our anthracite is inexhaustible, and that the 'mammoth vein' extends for 650 miles along the west bank of the Susquehanna (p. 147).

Mr. Martin says (p. 152) that Britain will feel, with tremendous effect, the blow to her prestige when the first vessel laden with coal weighs anchor in a British harbor. Three such blows were administered in 1896 by one Kentucky concern, and the attack has been continued this year by another.

J. J. Stevenson.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 276TH MEETING, SATURDAY, APRIL 24.

Mr. M. A. Carleton spoke on 'Climate as an Element in Wheat Environment,' his remarks being mainly a comparison of the conditions prevailing in the wheat belt of southern Russia with those found in the western United States. He stated that low temperature, accompanied by aridity, prevented the raising of spring wheat, and that the successful ripening of grain did not depend on the average temperature, but on the total temperature of the hottest months. Mr. Frederick V. Coville presented a paper on the 'Plantfood of the Wild Ducks in Chesapeake Bay,' and particularly of the canvas back and its favorite food of the tubers of the wild celery. A large portion of the best feeding ground of the upper Chesapeake was de-

stroyed a few seasons ago by a combination of strong winds and heavy snowfall, followed by cold, the result being that exceptionally low water was produced, ice formed on the exposed flats, and when the tide finally came in the plants were torn away and carried off. Mr. Coville noted the conditions under which the shallow water could be restocked with the wild celery, and stated that it had been successfully transplanted to Western lakes, with the desired result of causing the canvas backs to linger there on their migrations.

Mr. Coville also described 'The Water Hyacinth, *Piaropus crassipes*, as an obstruction to navigation in Florida,' saying that in some of the shallow rivers the accumulation of the plants impeded the progress of the steamers. He showed a view of steamers so surrounded by the water hyacinth that they appeared to be lying in a meadow, and described the experiments made with a view to the possibility of destroying the plants.

Mr. Lyster H. Dewey described 'The Eastern Migration of Certain Weeds in America,' saying that the general trend of weed migration in the States east of the Rocky mountains, except in New England, has been westward, corresponding with the direction of the progress of cultivation and the movement of the supply of field seeds. In New England weeds have spread to the eastward, as illustrated by the Canada Thistle, *Carduus arvensis*, and the Orange hawkweed, *Hieracium aurantiacum*, introduced into Vermont and New York, and spreading from these States eastward. Yellow daisy, *Rudbeckia hirta;* bracted plantain, *Plantago aristata;* low amaranth, *Amaranthus blitoides;* marsh elder, *Iva xanthifolia;* buffalo bur, *Solanum rostratum;* squirrel tail, *Hordeum jubatum*, and Russian Thistle, *Salsola kali tragus*, are given as instances of weeds that have spread to the eastward. While the westward migration of weeds has been largely through impure field seeds, the eastward movement appears to be chiefly along railroads, in baled hay, grain and wool.

277TH MEETING, SATURDAY, MAY 8.

THE entire evening was devoted to the presentation and discussion of a paper by Dr. C. Hart Merriam, on 'Suggestions for a New Method of Weighing Species and Subspecies,' which appeared in the last issue of SCIENCE.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the regular meeting of April 14, 1897, Mr. H. W. Turner read a paper on 'A new Amphibole-pyroxene rock and some Orbicular rocks from California.'

The new amphibole-pyroxene rocks consists of original augite and amphibole in grains, of nearly equal size, with a little quartz and some pyrrhotite. The rock contains numerous phenocrysts of brown amphibole, which contain in a poikilitic manner the constituents of the ground mass. This rock is one type of a very interesting series of basic igneous rocks found in the foot hills of Mariposa county, California.

Some orbicular rocks were exhibited, as well as an inclusion in granite, around which an aureole, composed of amphibole, had formed. The material of this aureole appears to have been segregated from the granite. Two specimens of dikes were exhibited, the center of each of which contained more silica than the borders. Reference was also made to dikes in the rainy lake region, shown by Lawson to have an interior portion more siliceous than the borders. It is well known, as a general rule, that the less siliceous elements crystallize out first in all rock magmas. The walls of the dike being cooler, the less siliceous minerals would crystallize out first along the border, and the more acid minerals be transferred by convection currents, or in part crowded out by the already crystallized material toward the interior. It is evident that along the borders of an intrusive area of great size the same phenomenon might be shown. We should simply have the case of one side of the dike. The laws of thermochemistry would appear to be applicable to this case, inasmuch as the heat generated by the crystallization of the minerals might aid in establishing convection currents to transport the residual siliceous constituents away from the already consolidated material.

Under the title 'Laccoliths in Folded Strata,' Mr. W. H. Weed described the occurrence of a number of lenticular masses of intrusive rock

in the axes of folds, in the mountain groups of the plains of Montana, and one of the front ranges of the Rocky Mountains. In applying the term laccolith to such masses there is a wide departure from the original use of the word. It is therefore used provisionally, the right being reserved to designate such concavo-convex lenticular masses by an appropriate name at a future time.

The presence of such intrusions is believed to be due to causes in marked contrast to those of laccoliths. On the normal laccolith the intrusion causes the arching of previously horizontal strata. In the masses described the intrusion follows or accompanies the folding and is dependent upon it; that folding is the cause and not the result of igneous intrusion. The author offers a theory to explain the intrusion of such masses, utilizing the discussion of folds by Willis and by Van Hise to show that intrusion from below would be most easy at the hinge of such uplifts or the arch of synclines, and that such intrusion could not penetrate far, owing to compression near the concave surface of arches, so that further intrusion would be along a strata or other bed of easy parting toward the center of the fold when the presence of an arch due to a competent strata of limestone would leave a space beneath of little compression and consequent easy filling by the liquid magma.

W. F. Morsell.

U. S. Geological Survey.

SCIENCE CLUB OF NORTHWESTERN UNIVERSITY.

At a meeting of the Science Club of Northwestern University, held on Friday evening, May 7th, inst., a paper was read by Miss Mary E. Gloss on the 'Mesophyll of Ferns.' The theory of the formation of the palisade tissue in intense sunlight does not seem to apply in the case of ferns. All the species examined were grown in diffused light, with one exception; some have palisade parenchyma and some have not; the presence or absence of the palisade parenchyma was nearly constant throughout each of the genera examined, which may prove to be a generic characteristic. The presence or absence of chlorophyll in tbe epidermis, the form and arrangement of the cells of the mesophyll, the size of the air spaces and the thickness of the mesophyll appear to be nearly constant in each of the genera examined. The genera most carefully examined were *Adiantum*, *Aspidium*, *Nephrolepis* and *Polypodium*. The investigation will be continued until a large number of genera has been covered.

Thomas F. Holgate,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

At the May meeting of the Texas Academy of Science, held on the evening of the 7th inst., the following papers were presented:

'The Properties of the Living Substance,' by Dr. Edmund Montgomery, of Hemstead, Texas.

'An Account of some Applications of the Bessel Functions to Astronomy,' by Harry Y. Benedict, of Cambridge, Mass.

'A Note on a Generalization of the Numbers of Couchy,' also by Mr. Benedict.

'Triazines and Triazoles,' by James R. Bailey and S. F. Acree.

'On the Constitution of a By-product obtained in the Preparation of Hydrazopropionic Acid,' by James R. Bailey and Henry B. Dechard.

The last named papers embody the results of some original work performed in the chemical laboratory of the State University, under the direction of Mr. Bailey, the senior author.

Major Dutton's address on the 'The Economics of Concentrated Capital,' and Professor Nagle's paper on 'Vertical Curves for Railways,' now in press, will be ready for distribution in a few days.

Frederic W. Simonds.

University of Texas.

NEW BOOKS.

Grundriss der Entwicklungsgeschichte der Menschen und der Säugetheere. Oscar Schultze. Zweite Hälfte. Leipzig, Engelmann. 1897. Pp. vii+468. M. 6.

Dynamic Sociology. Lester F. Ward. New York, D. Appleton & Co. 2d Ed. 1897. Vol. I., pp. xl+706. Vol. II., pp. vii+690.

Bird Life. Frank M. Chapman. New York, D. Appleton & Co. 1897. Pp. xii+269. $1.75.

Antiquities of Tennessee. Gates P. Thruston. Cincinnati, The Robert Clarke Co. 1897. Pp. xv+369.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, MAY 28, 1897.

CONTENTS:

Adaptation in Pathological Processes: WILLIAM H. WELCH 813
The Naples Zoological Station: S. E. MEEK 832
Zoological Society of London 834
Current Notes on Anthropology:—
Primitive Symbolic Decoration; Man's Speech to Brutes: D. G. BRINTON 835
Astrophysical Notes: E. B. F. 836
Current Notes on Meteorology:—
Recent Articles on Kite-flying; Deforestation and Climate; Acclimatization of the English in Ceylon; Recent Publications: R. DEC. WARD 837
Scientific Notes and News 838
University and Educational News 842
Discussion and Correspondence:—
Distribution of Marine Mammals: WM. H. DALL. *A Postscript on the Terminology of Types:* F. A. BATHER. *Organic Selection:* ROBERT M. PIERCE. *Euproctis Chrysorrhœa in Massachusetts:* SAMUEL HENSHAW 843
Scientific Literature:—
Das Tierreich: LEONHARD STEJNEGER. *Howard's Study in Insect Parasitism:* T. D. A. COCKERELL. *Marine Fossils from the Coal Measures of Arkansas:* FREDERIC W. SIMONDS. *Wheeler on the Clay Deposits of Missouri:* H. FOSTER BAIN 846
Scientific Journals:—
The American Chemical Journal: J. ELLIOTT GILPIN. *The American Geologist* 852
Societies and Academies:—
Chemical Society of Washington: V. K. CHESNUT. *Entomological Society of Washington:* L. O. H. *Anthropological Society of Washington:* J. H. MCCORMICK 855

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ADAPTATION IN PATHOLOGICAL PROCESSES.**

GRATEFUL as I am for the personal goodwill manifested by my selection as President of this Congress, I interpret this great and unexpected honor as an expression of your desire to give conspicuous recognition to those branches of medical science not directly concerned with professional practice, and as such I acknowledge it with sincere thanks.

All departments represented in this Congress are working together toward the solution of those great problems—the causes and the nature, the prevention and the cure, of disease—which have always been and must continue to be the ultimate objects of investigation in medicine. It is this unity of purpose which gives to the history of medicine, from its oldest records to the present time, a continuity of interest and of development not possessed in equal degree by any other department of knowledge. It is this same unity of purpose which joins together into a single, effective organism the component groups of this Congress, representing, as they do, that principle of specialization and subdivision of labor which, notwithstanding its perils, has been the great factor in medical progress in modern times.

Medical science is advanced not only by

* Address of the President before the Fourth Triennial Congress of American Physicians and Surgeons, held in Washington, May 4–6, 1897.

those who labor at the bedside, but also by those who in the laboratory devote themselves to the study of the structure and functions of the body in health and disease. It is one of the most gratifying results of the rapid advance in medical education in this country during the last few years that successful workers in the laboratory may now expect some of those substantial rewards which formerly were to be looked for almost exclusively in the fields of practical medicine and surgery. We already have abundant assurance that the steady improvement in opportunities and recompense and other material conditions essential for the prosecution of scientific work in medicine will enable this country to contribute to the progress of the medical sciences a share commensurate with its great resources and development in civilization.

The subject of 'Adaptation in Pathological Processes,' which I have selected for my address on this occasion, is one which possesses the broadest biological, as well as medical, interests. It is this breadth of scientific and practical interest that must justify my choice of a theme which involves many technical considerations and many problems among the most obscure and unsettled in the whole range of biology and of medicine.

I shall employ the epithet 'adaptive' to describe morbid processes which bring about some sort of adjustment to changed conditions due to injury or disease. In view of the more technical and restricted meaning sometimes attached to the term 'adaptation' in biology, objection may be made to this broad and general application of the word in pathology; but no more suitable and convenient epithet than 'adaptive' has occurred to me to designate the entire group of pathological processes whose results tend to the restoration or compensation of damaged structure or function, or to the direct destruction or neutralization of injurious agents. Processes which may be described variously as compensatory, regenerative, self-regulatory, protective, healing, are thus included under adaptive pathological processes. These processes are, in general, more or less advantageous or useful to the individual; but for reasons which will be stated later the conception of pathological adaptation and that of advantage to the individual are not wholly coextensive.

Within the limits of an address I cannot hope to do more than direct attention to some of those aspects of the subject which seem to me to be of special significance. Although most striking examples of adaptation are to be sought in comparative and vegetable pathology, what I shall have to say will relate mostly to human pathology. My purpose is not to point out the beauties or the extent of adaptations in pathological processes, but rather to say something concerning the general mechanism of their production and the proper attitude of mind regarding them, and to illustrate the general principles involved by a few representative examples.

It has been contended that the conception of adaptation has no place in scientific inquiry; that we are justified in asking only by what means a natural phenomenon is brought about, and not what is its meaning or purpose; in other words, that the only question open to scientific investigation is How? and never Why? I hope to make clear by what follows in what light I regard this question, and in this connection I shall simply quote Lotze, who, beginning as a pathologist, became a great philosopher: "Every natural phenomenon may be investigated not only with reference to the mathematical grounds of its possibility and the causes of its occurrence, but also as regards the meaning or idea which it represents in the world of phenomena."

The most wonderful and characteristic attribute of living organisms is their active adaptation to external and internal conditions in such a way as tends to the wel-

fare of the individual or of the species. Of the countless physiological examples which might be cited to illustrate this principle, I select, almost at random, the preservation of the normal temperature of the body in warm-blooded animals under varying external temperatures and varying internal production of heat, the regulation of respiration according to the need of the tissues for oxygen, the influence of the load upon the work performed by muscles, the accommodation of the heart to the work demanded of it, the response of glands to increased functional stimulation, the adjustment of the iris to varying degrees of illumination, the influence of varying static conditions upon the internal architecture of bone.

The most striking characteristic of these countless adaptations is their apparent purposefulness. Even if it be true, as has been said by Lange, that "the formal purposefulness of the world is nothing else than its adaptation to our understanding," it is none the less true that the human mind is so constituted as to desire and seek an explanation of the adaptations which it finds everywhere in organic nature. From the days of Empedocles and of Aristotle up to the present time there have been two leading theories to explain the apparent purposefulness of organic nature—the one, the teleological, and the other, the mechanical theory. The teleological theory, in its traditional signification, implies something in the nature of an intelligence working for a predetermined end. So far as the existing order of nature is concerned, the mechanical theory is the only one open to scientific investigation, and it forms the working hypothesis of most biologists. This theory, in its modern form, seeks an explanation of the adaptations of living beings in factors concerned in organic evolution. What these factors are we know only in part. Those which are most generally recognized as operative are variation, natural selection and heredity. That additional factors, at present little understood, are concerned seems highly probable. The acceptance of the explanation of physiological adaptations furnished by the doctrine of organic evolution helps us, I believe, in the study of pathological adaptations.

As the word 'teleology' has come to have, in the minds of many, so bad a repute in the biological sciences, and as I desire, without entering into any elaborate discussion of the subtle questions here involved, to avoid misconceptions in discussing subjects whose ultimate explanation is at present beyond our ken, I shall here briefly state my opinion that all of those vital manifestations to which are applied such epithets as adaptive, regulatory, regenerative, compensatory, protective, are the necessary results of the action of forms of energy upon living matter. The final result, however useful and purposeful it may be, in no way directly influences the chain of events which leads to its production, and, therefore, the character of the result affords no explanation whatever of the mechanism by which the end, whether it appear purposeful or not, has been accomplished. In every case the ultimate aim of inquiry is a mechanical explanation of the process in question. Notwithstanding valuable contributions, especially within recent years, toward such mechanical explanations, we are still far removed from the attainment of this aim.

The knowledge of the fact that the living body is possessed of means calculated to counteract the effects of injurious agencies which threaten or actually damage its integrity must have existed as long as the knowledge of injury and disease, for the most casual observation teaches that wounds are repaired and diseases are recovered from. It is no part of my present purpose to trace the history of the speculations or even of the development of our

exact knowledge concerning the subjects here under consideration. I cannot refrain, however, from merely referring to the important *rôle* which the conception of disease as in some way conservative or combative in the presence of harmful influences has played from ancient times to the present in the history of medical doctrines. Whole systems of medicine have been founded upon this conception, clothed in varying garb. There is nothing new even in the image, so popular nowadays, representing certain morbid processes as a struggle on the part of forces within the body against the attacks of harmful agents from the outer world. Indeed, Stahl's whole conception of disease was that it represented such a struggle between the anima and noxious agents. What lends especial interest to these theories is that then, as now, they profoundly influenced medical practice and were the origin of such well-known expressions as *vis medicatrix naturæ* and *medicus est minister naturæ*.

It is needless to say that there could be no exact knowledge of the extent of operation or of the nature of processes which restore or compensate damaged structures and functions of the body or combat injurious agents, before accurate information was gained of the organization and workings of the body in health and in disease. Although the way was opened by Harvey's discovery of the circulation of the blood, most of our precise knowledge of these subjects has been obtained during the present century, through clinical observations and pathological and biological studies. In the domain of infectious diseases wonderful and hitherto undreamed-of protective agencies have been revealed by modern bacteriological discoveries. Here, as elsewhere in medicine, the experimental method has been an indispensable instrument for discoveries of the highest importance and for the comprehension of otherwise inexplicable facts. Very interesting and suggestive results, shedding light upon many of the deeper problems concerning the nature and power of response of living organisms to changed conditions, have been obtained in those new fields of experimental research called by Roux the mechanics of development of organisms and also in part designated physiological or experimental morphology. Although we seem to be as far removed as ever from the solution of the most fundamental problem in biology, the origin of the power of living beings to adjust themselves actively to internal and external relations, we have learned something from these investigations as to the parts played respectively by the inherited organization of cells and by changes of internal and external environment in the processes of development, growth and regeneration.

In physiological adaptations, such as those which have been mentioned, the cells respond to changed conditions to meet which they are especially fitted by innate properties, determined, we must believe, in large part by evolutionary factors. In considering pathological adaptations the question at once suggests itself whether the cells possess any similar peculiar fitness to meet the morbid changes concerned; whether, in other words, we may suppose that evolutionary factors have operated in any direct way to secure for the cells of the body properties especially suited to meet pathological emergencies. Can we recognize in adaptive pathological processes any manifestations of cellular properties which we may not suppose the cells to possess for physiological uses? This question appears to me to be of considerable interest. I believe that it can be shown that most pathological adaptations have their foundation in physiological processes or mechanisms. In the case of some of these adaptations, however, we have not sufficiently clear insight into the real nature of the pathological

process nor into all of the physiological properties of the cells concerned to enable us to give a positive answer to the question.

While we must believe that variation and natural selection combined with heredity have been important factors in the development and maintenance of adjustments to normal conditions of environment, it is difficult to see how they could have intervened in any direct way in behalf of most pathological adaptations.

An illustration will make clear the points here involved. Suppose the human race, or any species of animal, to lack the power to compensate the disturbances of the circulation caused by a damaged heart-valve, and that an individual should happen to be born with the exclusive capacity of such compensation. The chances are that there would arise no opportunity for the display of this new capacity, and it is inconceivable that the variety would be perpetuated through the operation of the law of survival of the fittest by natural selection, unless leaky or clogged heart-valves became a common character of the species. When, however, we learn that the disturbance of circulation resulting from disease of the heart-valves is compensated by the performance of increased work on the part of the heart, and that it is a general law that such prolonged extra work leads to growth of muscle, we see at once that this compensation is only an individual instance of the operation of a capacity which has abundant opportunities for exercise in normal life where the influence of natural selection and other factors of evolution can exert their full power.

In a similar light we can regard other compensatory and functional pathological hypertrophies; indeed, I believe, also to a considerable extent the pathological regenerations, inflammation and immunity, although here the underlying factors are, of course, different.

We may, however, reasonably suppose that natural selection may be operative in securing protective adjustments, such as racial immunity, against morbific influences to which living beings are frequently exposed for long periods of time and through many generations.

These considerations help us to explain the marked imperfections of most pathological adaptations as contrasted with the perfection of physiological adjustments, although I would not be understood to imply that the absence of the direct intervention of natural selection in the former is the sole explanation of this difference. The cells are endowed with innate properties especially fitted to secure physiological adaptations. No other weapons than these same cells does the body possess to meet assaults from without, to compensate lesions, to restore damaged and lost parts. But these weapons were not forged to meet the special emergencies of pathological conditions. Evolutionary factors have not in general intervened with any direct reference to their adaptation to these emergencies. Such fitness as these weapons possess for these purposes comes primarily from properties pertaining to their physiological uses. They may be admirably fitted to meet certain pathological conditions, but often they are inadequate. Especially do we miss in pathological adjustments that coordinated fitness so characteristic of physiological adaptations. So true is this that the propriety of using such terms as compensation and adaptation for any results of pathological processes has been questioned.

A heart hypertrophied in consequence of valvular lesion does not completely restore the normal conditions of the circulation. Experience has shown that a kidney hypertrophied in consequence of deficiency of the other kidney is more susceptible to disease than the normal organ. What an incomplete repair of defects is the formation of scar-tissue, and with what inconveniences and even dangers may it be attended in

some situations! If we look upon inflammation as an attempt to repair injury, and, therefore, as an adaptive process, with what imperfections and excesses and disorders and failures is it often associated! How often in some complex pathological process, such as Bright's disease or cirrhosis of the liver, can we detect some adaptive features, attempts at repair or compensation, but these overshadowed by disorganizing and harmful changes!

It is often difficult to disentangle in the complicated processes of disease those elements which we may appropriately regard as adaptive from those which are wholly disorderly and injurious. There are usually two sides to the shield, and one observer from his point of view may see only the side of disorder, and another from a different point of view only that of adaptation.

The conception of adaptation in a pathological process is not wholly covered by that of benefit to the individual. I understand, as has already been said, by an adaptive pathological process one which in its results brings about some sort of adjustment to changed conditions, due to injury or disease. This adjustment is usually, wholly or in part, advantageous to the individual; but it is not necessarily so, and it may be harmful. The closure of pathological defects by new growths of tissue is a process which must be regarded as adaptive. But one would hardly describe as advantageous the scar in the brain which causes epilepsy. A new growth of bone to fill in defects is often highly beneficial; but what grave consequences may result from thickening of the skull to help fill the space left by partial arrest in development of the brain in embryonic life or infancy! We see here, as everywhere, that "Nature is neither kind nor cruel, but simply obedient to law, and, therefore, consistent."

In turning now to the more special, but necessarily fragmentary, consideration of a few of the pathological processes in which adaptation, in the sense defined, is more or less apparent, I shall have in view the answers to those two questions, **What is the meaning of the process?** and **How is it caused?** which confront us in our investigation of all natural phenomena. At the outset it must be admitted that our insight into the nature of many of these processes is very imperfect, and that here answers to the world-old riddles Why? and How? are correspondingly incomplete and liable to err.

Although almost all of the elementary morbid processes, even the degenerations and death of cells, may, under certain conditions of the body, serve a useful purpose, the preeminent examples of pathological adaptation, in the sense of restoration or compensation of damaged structure or function, or the direct destruction or neutralization of injurious agents, are to be found among the compensatory hypertrophies, the regenerations and the protective processes. To this last ill-defined group I refer parasiticidal and antitoxic phenomena, and some of the manifestations of inflammation, and perhaps also of fever. In the last analysis these protective processes, no less than the others mentioned, must depend upon the activities of cells.

As it is manifestly impossible within the limits of a general address to attempt a detailed consideration of any large number of these adaptive pathological processes, and as such consideration would necessarily involve the discussion of many technical and doubtful points, I have thought that my purpose would be best served by the selection of a few representative examples.

The compensatory hypertrophies afford admirable illustrations of certain fundamental principles regarding adaptations in pathology which I have already stated. The hypertrophy secures a functional adjustment, often of a highly beneficial character, to certain morbid conditions. This useful purpose is attained by a succession of

events determined from beginning to end by the necessary response of cells and tissues, in consequence of their inherent organization, to the changed conditions. Given the changed conditions on the one hand, and the organization of the cells on the other, the result must follow as surely as night follows day, and this final result influences the preceding series of events no more in the one case than in the other. That the cells possess the particular organization determining the manner of their response to these changed conditions, and, therefore, the beneficial character of the result, is dependent upon innate properties whose fitness for the purpose doubtless has been largely fixed by evolutionary factors, operating, however, mainly in behalf of physiological functions and not directly toward pathological adjustments. In correspondence with this view we find that our knowledge of the manner of production of the compensatory hypertrophies of various organs and tissues stands in direct relation to our knowledge of the physiology of the same organs and tissues.

Those compensatory hypertrophies into the mechanism of whose production we have the clearest insight are referable to increased functional activity, and are, therefore, spoken of as work-hypertrophies. This has been proved for the muscular hypertrophies and compensatory hypertrophy of the kidney, but the demonstration is not equally conclusive for the compensatory hypertrophy of other glands. I know, however, of of no instance in which this factor in the explanation can be positively excluded.

The relationship between increased functional activity and hypertrophy is so evident in many cases that there is strong presumption in favor of this explanation of those glandular compensatory hypertrophies which have not as yet been clearly referred to the class of functional hypertrophies. The very occurrence of compensatory hypertrophy of an organ may direct attention to the fact that it is endowed with definite functions, and the conditions under which the hypertrophy occurs may shed light upon the nature of these functions. I need only remind you of the significance, from this point of view, of the compensatory hypertrophy of the thyroid, adrenal, pituitary, and other glands with internal secretions. I fail to see why Nothnagel should consider *a priori* improbable the occurrence of compensatory hypertrophy of one sexual gland after loss of the other, even before sexual maturity, or why Ribbert, who has apparently demonstrated experimentally such an occurrence, should find it necessary to seek the explanation in reflex nervous influences or mere hyperæmia. The so-called secondary sexual characters and the changes following castration, including the influence upon a hypertrophied prostate, point to important, even if little understood, functions which for the present we can, perhaps, best attribute to so-called internal secretions of these sexual organs.

The name compensatory hypertrophy is sometimes applied to growths of tissue that merely take the place of another kind of tissue which has fallen out, as, for example, the growth of adipose tissue around a shrunken kidney or pancreas, or between atrophied muscle-fibres. Here there is only compensation of space, but no compensation of structure or function. Such hypertrophies and growths are described better as complementary than compensatory.

Familiar examples of pathological hypertrophies from increased work are the hypertrophy of the heart from valvular disease and other causes, that of the muscular coats of canals and bladders behind some obstruction, and that of one kidney after loss or atrophy of the other.

In order to understand fully the manner of production of work-hypertrophy of a part, resulting from some morbid condition, it is

essential to know the nature of the disturbances induced by the underlying morbid condition, how these disturbances excite increased functional activity of the part which becomes hypertrophied, and what the relationship is between this greater activity and the increased growth of the part.

It is impossible on this occasion to go through the whole list of compensatory hypertrophies with reference to the application of these principles. In no instance can the requirements stated be completely met in the present state of our knowledge. It will suffice for an understanding of the principles involved, and it is only with these that I am now concerned, if I take a concrete example. I select the classical and best studied one—compensatory hypertrophy of the heart. I trust that I shall be pardoned for selecting so commonplace an illustration, as the main points involved must be familiar to most of my audience; but it is possible that the application made of them may not be equally familiar. The only matters essential to my present line of argument are the mechanism of production of the hypertrophy and the general character of the adaptation thereby secured.

The heart, like other organs of the body, does not work ordinarily up to its full capacity, but it is capable of doing at least three or four times its usual work. The excess of energy brought into play in doing this extra work is called conveniently, although not without some impropriety, 'reserve force.' It has been proved experimentally that this storehouse of reserve power is sufficient to enable the healthy heart, at least that of a dog, to accommodate itself at once or after a few beats to high degrees of insufficiency or obstruction at its valvular orifices without alteration in the mean pressure and speed of the blood in the arteries. But even so tireless and accommodating an organ as the heart cannot be driven at such high pressure without sooner or later becoming fatigued, and consequently so dilated as to fail to meet the demands upon it. If it is to continue long the extra work, it must receive new increments of energy.

The cardiac muscle is far less susceptible to fatigue than the skeletal muscles, but that it may become fatigued seems to me clear.

Leaving out of consideration some doubtful causes of cardiac hypertrophy, such as nervous influences, the various morbid conditions which lead to this affection are such as increase either the volume of blood to be expelled with each stroke or the resistance to blood-flow caused by the pressure in the arteries or by narrowing at one of the valvular orifices, or both. Unless some regulating mechanism steps in, each of these circulatory disturbances must increase the resistance to contraction of the cardiac muscle, and it is evident that the heart must do extra work if it is to pump the blood through the arteries with normal pressure and speed. It is, however, no explanation of this extra work simply to say that it occurs because there is demand for it. Increased work by the heart in cases of disease of its nutrient arteries would often meet a most urgent demand on the part of the body, but here the heart flags and fails.

The physiologists have given us at least some insight into the mechanism by which the heart responds through increased work to the circulatory disturbances which have been mentioned. These disturbances all increase the strain on the wall of one or more of the cavities of the heart; in other words, increase the tension of the cardiac muscle, in much the same way as a weight augments the tension of a voluntary muscle. Now it is a fundamental physiological law that with a given stimulus greater tension of a muscle, within limits, excites to more powerful contraction, and thus to the per-

formance of greater work. It seems clear that this law applies to the muscle of the heart, as well as to voluntary muscle. We do not know precisely how increased tension facilitates the expenditure of greater muscular energy.

Another well-known fact in the mechanics of muscle is of importance in this connection. With increase of muscular tension under a given stimulus, a point is reached where the extent of contraction is diminished, although the mechanical work done, determined by multiplying the height to which the load is lifted by the weight of the load, is increased. This law applied to the heart, whose contractions are always maximal for the conditions present at any given time, signifies that, with increased resistance to the contraction of the muscular wall of one of its cavities, this cavity will empty itself during systole less completely than before. In other words, dilatation occurs, and, as has been shown by Roy and Adami, to whom we owe important contributions on this as well as on many other points relating to the mechanics of the heart, dilatation regularly antedates hypertrophy. This primary dilatation, however, is not to be looked upon as evidence of beginning heart failure, for, as these investigators pointed out, it is within limits only an exaggeration of a physiological condition, and can be subsequently overcome by hypertrophy which, in consequence of increase in the sectional area of the muscle, lessens the strain upon each fibre, and thereby permits it to shorten more during contraction. If this result is completely secured we have simple hypertrophy. More often the dilatation remains, and must necessarily remain, and we have excentric hypertrophy, which secures, for a time at least, adequate, but I do not think we can say perfect, compensation.

The weight of existing evidence favors the view that the power of the heart to adapt its work to the resistance offered resides primarily in its muscle-cells, and not in intrinsic or extrinsic nervous mechanisms, although doubtless these latter in various ways, which cannot be here considered, influence and support this regulating capacity. Nor can I here pause to discuss the influence of blood-supply to the cardiac muscle upon the force of ventricular contraction, although Porter has demonstrated that this is important.

In tracing the steps from the primary morbid condition to the final hypertrophy, we have thus far had to deal mostly with known mechanical factors. We now come to the question, How does increased functional activity lead to increased growth?

Inasmuch as greater functional activity is regularly associated with a larger supply of blood to the more active part, the view is advocated by many that the increased growth is the direct result of this hyperæmia, and one often encounters, especially in biological literature, this opinion expressed as if it were an indisputable fact. There is, however, no conclusive proof of this doctrine, and many facts speak against it. The examples from human pathology commonly cited to support the doctrine that local active hyperæmia incites growth of cells are, so far as I am able to judge, complicated with other factors, such as injury, inflammation or trophic disturbances. Transplantation-experiments, such as John Hunter's grafting the cock's spur upon the cock's comb, sometimes adduced in this connection, are not decisive of this question, for here a new circumstance is introduced which some suppose to be the determining one for all morbid cell-growth, namely, the disturbance of the normal equilibrium between parts. Local active hyperæmia may exist for a long time without evidence of increased growth in the congested part. To say that the hyperæmia must be functional is at once to concede that it is not

the sole factor. Experiments from Bizzozero's laboratory, by Morpurgo and by Penzo, indicate that local hyperæmia due to vasomotor paralysis, or to the application of heat, favors cell multiplication in parts where proliferation of cells is a normal phenomenon, or is present from pathological causes, but that it is incapable of stimulating to growth cells whose proliferating power is suspended under physiological conditions, as in developed connective tissue, muscles and the kidneys.

It has been usually assumed that the way in which local hyperæmia may stimulate cell-growth is by increasing the supply of nutriment to cells. The trend of physiological investigation, however, indicates that the cell, to a large extent, regulates its own metabolism. If the cell needs more food, of course, it cannot get it unless the supply is at hand, and in this sense we can understand how a larger supply of blood may be essential to increased growth, but this is a very different thing from saying that the augmented blood-supply causes the growth.

It is by no means clear that the question as to the influence of increased blood-supply upon cell-growth is identical with that of increased lymph-supply. The experiments of Paschutin and of Emminghaus, from Ludwig's laboratory, nearly a quarter of a century ago, indicate that local hyperæmia due to vasomotor paralysis does not, as a rule, increase the production of lymph; and more recent experiments, although not wholly concordant in their results upon this point, tend to the same conclusion. Functional activity, however, has a marked influence in increasing the quantity and affecting the quality of lymph in the active part. Our knowledge of the physical and chemical changes in working muscles and glands enables us to conceive why this should be so, for all are now agreed that the formation of lymph is due not simply to filtration from the blood-plasma, but also to diffusion, and some believe likewise to active secretion by the capillary endothelium. Doubtless arterial hyperæmia is essential to the maintenance of the increased flow of lymph in working organs.

There are difficulties in the way of supposing that increased supply of lymph in itself furnishes the explanation of cell-growth, and especially of that which characterizes hypertrophy of muscles and glands. Pathologists have frequent opportunities to study the effects of all degrees of increased production and circulation of lymph associated with venous hyperæmia. A kidney or a muscle may from this cause be subjected for months and years to an excess of lymph-flow, but there is no demonstration of any consequent hypertrophy or hyperplasia of renal epithelium or muscle-cell. It is true that the chemical composition of the lymph is not the same as that of lymph resulting from increased function, and it is possible that in this chemical difference lies the kernel of the whole matter. It may also be urged that in venous hyperæmia there are circumstances which restrain or prevent growth. Nevertheless, if overfeeding, merely in consequence of increased supply of nutriment, were the real explanation of work-hypertrophies, one would expect to find some evidence of this in the class of cases mentioned.

Ribbert has recently given a new shape to the doctrine that local hyperæmia excites growth. While rejecting the usual explanation that it does so by supplying more food, he contends that distention of the bloodvessels and lymph-spaces, by mechanically disturbing the mutual relations of parts, removes obstacles to growth. This theory cannot be advantageously discussed until the fact is first established that uncomplicated local hyperæmia does incite growth.

As the matter now stands, it seems to me that any satisfactory explanation of the cell-growth causing work-hypertrophies must start from physical or chemical changes in the muscle- or gland-cell itself directly connected with the increased function. These changes are the *primum mobile*, and, however important increased supply of blood or lymph may be in the subsequent chain of events, it is not the determining factor. The whole problem is part of the general one of the causes of pathological cell-growth, to which I shall have occasion to refer again.

It is interesting to note that not all kinds of excess of functional activity lead to hypertrophy. A heart may beat for years faster than normal without becoming hypertrophied. Small movements of muscle, often repeated, do not cause hypertrophy. It would appear that the amount of work done in each functional act must attain a certain height in order to stimulate growth. On the other hand, if the muscle be stretched beyond certain limits, it does not hypertrophy; on the contrary, it may atrophy, as may be seen in greatly distended canals and cavities with muscular walls. This behavior is also in accordance with physiological observations.

The compensatory hypertrophy of muscle seems to be due mainly to increase in the size of cells, although there are observations indicating that they may also multiply. That of most glands is referable to increase both in number and size of cells. Within four or five days after extirpation of a kidney, karyokinetic figures may be found in increased number in the cells of the remaining kidney.

The general character of the adaptation secured by compensatory hypertrophy of the heart is sufficiently well known. I wish to point out certain of its imperfections. I shall not dwell upon the well-known abnormal conditions, with their remote consequences, of the systemic or pulmonary circulation, which are present during the stage of compensation, nor shall I speak of the various circumstances which may interfere with the establishment of compensatory hypertrophy.

The muscle of a hypertrophied heart is sometimes compared to that of the blacksmith's arm, and the statement is made that there is no reason inherent in the muscle itself why the one should fail more than the other. This may be true, but it is not self-evident. Exercise may influence in various ways the nutrition, function and growth of muscle as well as of other parts. Mere increase in bulk is a coarse effect. Quality may be improved as well as quantity. The biggest muscle is not necessarily the best or the most powerful. As every trainer knows, various conditions under which work is done influence the result. Increase in the reserve energy of the heart, secured by judicious exercise—and this is the main factor in endurance—probably cannot be attributed mainly to hypertrophy; indeed, enlargement of this organ from exercise is often a serious condition. Much more might be said in this line of thought, but I have indicated why it seems to me unjustifiable to assume, without further evidence, that the condition of the muscle in pathological hypertrophies is necessarily identical in all respects with that in physiological hypertrophies.

There is an important difference in the working conditions between most hypertrophied hearts and the normal heart. Although the maximal available energy of a hypertrophied heart during compensation is greater than that of the normal heart, clinical experience shows that in the majority of cases the energy available for unusual demands—that is, the so-called reserve force—is less in the former than in the latter. Sometimes, especially when the hypertrophy has developed in early life, the

hypertrophied heart is at no disadvantage in this respect. As pointed out with especial clearness by Martius, the significance of this alteration in the ratio normally existing between the energy expended for ordinary needs and that available for unusual demands is that it furnishes an explanation of the greater liability of the hypertrophied heart to tire upon exertion. Fatigue of the heart is manifested by dilatation of its cavities, and when this dilatation from fatigue is added to that already existing in most cases, relative insufficiency of the mitral or tricuspid valve is likely to occur, and the compensation is, at least for a time, disturbed. The circulation through the coronary arteries, whose integrity is so important for the welfare of the heart, is impaired, and a vicious circle may be established. Notwithstanding the valuable contributions from the Leipzig clinic as to the frequency of various anatomical lesions in the muscles of hypertrophied hearts, it does not seem to me necessary to have recourse to them as an indispensable factor in the explanation of the breakage of compensation; but I shall not here enter into a discussion of the general subject of the causes of failure of compensation.

I have described, with some detail, although very inadequately, the manner of production of compensatory hypertrophy of the heart, in order, by this representative example, to make clear what seem to me to be certain general characteristics of many adaptive pathological processes, and I beg here to call attention especially to the following points. As has been emphasized by Nothnagel and others, no teleological idea or form of language need enter into the explanation of the mechanism of the process. The final result is the necessary consequence of the underlying morbid conditions. We have satisfactory mechanical explanations for essential steps in the process, and there is no reason to assume that other than mechanical factors are concerned in those vital manifestations which at present we are unable to explain by known physical and chemical forces. The properties of the cells which determine the character of their response to the changed conditions are none other than their well-known physiological properties. The adaptation finally secured, admirable as it is in many respects, and perhaps adequate for a long and active life, is generally attended with marked imperfections, and, strictly speaking, is not a complete compensation. It does not present that coordinate and special fitness which we are accustomed to find in physiological adaptations, for the explanation of which so much has been gained by the study of the factors concerned in organic evolution.

It may be argued that under the circumstances no better kind or degree of adaptation can be conceived of than that which actually occurs, and that the operation of evolutionary factors, with special reference to the adjustment of the organism to the conditions causing cardiac hypertrophy, could not secure any better result. I think that it is not difficult to conceive how improvements might be introduced. It is, however, permissible to suppose that the introduction into the workings of the organism of some better mechanism to compensate the morbid conditions might be at the sacrifice of more important physiological attributes of the body. More perfect pathological adaptations might in many instances involve a deterioration of the physiological characters of the species. It is often the case that the more highly organized living beings lack some capacity possessed by those lower in the scale of organization to resist or compensate injury and disease. This is notably true of the power to regenerate lost parts. It is, however, along the lines of improvement in the physiological characters of the individual or species that the opportunity often lies

for securing increased resistance to disease or better pathological adaptations.

It would be interesting to continue our consideration of the compensatory hypertrophies by an examination of those of glandular organs from points of view similar to those adopted for the heart. For the kidney, at least, the materials are at hand for such a purpose, but, as I desire in the limited time at my disposal to touch upon other varieties of pathological adaptation, I must refer those interested especially to the investigations of Grawitz and Israel, Ribbert, Nothnagel and Sacerdotti as to the conditions underlying compensatory hypertrophy of the kidney. I can likewise merely call attention to the interesting researches of Ponfick upon the most wonderful of the compensatory hypertrophies in higher animals, that of the liver. Ponfick, as is well known, has demonstrated that, after removal of three-fourths of this organ, new liver-substance, with normal functions, is recreated from the remainder and to an amount nearly equalling that which was lost.

The chapter of pathological adaptations in bones and joints I shall leave untouched, notwithstanding the admirable illustrations which might be drawn from this domain.

There is no more fascinating field for the study of pathological adaptations with reference to the mechanical factors involved than that furnished by the blood-vessels, as has been shown especially by the brilliant researches of Thoma. With wonderful precision can a vessel or system of vessels adjust itself to changes in the pressure, velocity and quantity of blood, and thereby serve the needs of the tissues for blood. Under pathological, as well as physiological, conditions this adjustment may be brought about not only through the agency of vasomotor nerves and the physical properties of the vascular wall, but also, when the necessity arises, by changes in the structure of the wall.

The changes in the circulation introduced by the falling-out of the placental system at birth are essentially the same as those resulting from amputation of an extremity, and the consequent alterations in the structure of the umbilical artery are identical with those in the main artery of the stump after amputation. The closure of the ductus Botalli and the ductus venosus soon after birth, and, still better, transformations of vessels in the embryo, furnish physiological paradigms for the development of a collateral circulation. Many other illustrations might be cited, did time permit, to show that in the processes of normal development, growth and regressive metamorphosis of parts, both before and after birth, and in menstruation and pregnancy, changed conditions of the circulation arise analogous to certain ones observed under pathological circumstances, and that the mode of adjustment to these changes by means of anatomical alterations in the vessels may be essentially the same in the physiological as in the morbid state. I see in these facts an explanation of the relative perfection of certain vascular adaptations to pathological or artificial states, as may be exemplified by changes in a ligated artery and by the development of a collateral circulation. The mechanisms by which the adjustments are secured have, in consequence of their physiological uses, for reasons already explained, a special fitness to meet certain pathological conditions. That this fitness should be greater in youth than in old age is in accordance with laws of life, indicated with especial clearness by Minot in his interesting studies on 'Senescence and Rejuvenation.'

But these mechanisms are not equally well adapted to meet all morbid changes in the vessels. Although Thoma's interpretation of the fibrous thickening of the inner lining of vessels in arterio-sclerosis and aneurism, as compensatory, or, as I should

hypertrophied heart is at no disadvantage in this respect. As pointed out with especial clearness by Martius, the significance of this alteration in the ratio normally existing between the energy expended for ordinary needs and that available for unusual demands is that it furnishes an explanation of the greater liability of the hypertrophied heart to tire upon exertion. Fatigue of the heart is manifested by dilatation of its cavities, and when this dilatation from fatigue is added to that already existing in most cases, relative insufficiency of the mitral or tricuspid valve is likely to occur, and the compensation is, at least for a time, disturbed. The circulation through the coronary arteries, whose integrity is so important for the welfare of the heart, is impaired, and a vicious circle may be established. Notwithstanding the valuable contributions from the Leipzig clinic as to the frequency of various anatomical lesions in the muscles of hypertrophied hearts, it does not seem to me necessary to have recourse to them as an indispensable factor in the explanation of the breakage of compensation; but I shall not here enter into a discussion of the general subject of the causes of failure of compensation.

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defects in the tissues, and in interpreting the growth as for the purpose of regeneration or filling up a defect? Differences of opinion upon this subject are illustrated by the different interpretations of the cell-proliferations in acute and chronic inflammations; some pathologists considering these to be essentially regenerative and compensatory; others regarding them, at least in large part, as directly incited by inflammatory irritants and not to be ranked wholly with the regenerative processes.

The doctrine of Virchow was long accepted without question, that inflammatory cell-growth is the result of the action of external stimuli, the so-called inflammatory irritants, upon the cells, which are thereby directly incited to grow and multiply. The attack upon this doctrine has been led most vigorously by Weigert, who denies absolutely the power of any external agencies to stimulate directly cells to proliferation. He considers that to concede such a bioplastic power to external agents is equivalent to the acceptance of a kind of spontaneous generation of living matter.

Weigert's views upon this subject have had undoubtedly a most fruitful influence upon pathology. It has been such an influence as a good working hypothesis, whether finally demonstrated to be true or not, has often had in the development of science. In putting to the test of actual observation Weigert's hypothesis we have been led to recognize the frequency and the importance of primary injuries to cells inflicted by external agencies. Not only various degenerations and necroses of entire cells, but more subtle and partial damage of cytoplasm and nucleus, have been made the subject of special study. It has been recognized that our older methods of hardening tissues reveal often only very imperfectly the finer structure of cells, and new and better methods have been introduced which enable us to detect more delicate lesions of cell-substance which formerly escaped attention, as is well illustrated in recent studies in neuropathology. Weigert's postulate of some primary injury to the tissues as the immediate effect of mechanical, chemical and other external agencies, which were formerly regarded as the direct stimuli of cell-growth and multiplication, has been fulfilled in many instances where such damage had previously been overlooked or unsuspected. It is his belief that in cases where we cannot now detect such primary injury more thorough search and better methods will enable us to do so. One may, of course, reasonably cherish such an expectation; but at the same time we must recognize the fact that morbid cell-proliferations occur under circumstances where we cannot at present associate them with any demonstrable primary injury to the tissues—indeed, in some cases where our insight into the structure of the part seems to be so clear and satisfactory that one is very reluctant to admit the existence of an undetected damage to the cells.

Perhaps the most important modification of former pathological conceptions, resulting from the belief that cell-growth is caused by primary defects and injuries of tissue, relates to the chronic interstitial inflammations or fibroid processes. The older view that in these processes the active and essential feature of the disease is the new growth of connective tissue, which strangles the more highly organized cells of the part, has been replaced to a large extent by the opinion that the primary and most important lesion is the degeneration, atrophy or necrosis of the more specialized cells, whose place is taken by the new growth of interstitial tissue. In many instances, as in fibroid patches in the myocardium, and in many scleroses of the central nervous system, this latter conception affords the best and most natural interpretation of the facts.

There are, however, great difficulties in explaining all chronic interstitial inflammations by this doctrine, and I must take side with those who admit the occurrence, for example in the kidney and in the liver, of primary interstitial inflammations characterized by proliferation of the connective tissue and endothelial cells.

Indeed, it seems to me that Weigert's formula is too narrow to cover all of the observed facts concerning cell-proliferation. Essential features of the theory that cells cannot be directly stimulated to growth by external agents were present in Boll's doctrine of border warfare between neighboring cells. Weigert's presentation of this theory is in a far more acceptable shape than that of Boll. A still more comprehensive statement of the general theory is that cells are incited to growth through removal of obstacles to growth in consequence of some disturbance in the normal relations or equilibrium of the cells with surrounding parts. The capacity to proliferate must be present in the cells, but with the cessation of growth this capacity is rendered latent or potential by the establishment of definite relations or an equilibrium between cells and neighboring parts, including under the latter not only adjacent cells, but also basement-substance, lymphatics, bloodvessels, tissue-juices, chemical substances, etc. It is evident that under these circumstances in only two ways can the cells be incited to growth, either by removal of resistance or obstacles to growth, or by an increase in the formative energy resident within the cell, and that in either way energy must be used, whether it be employed to remove obstacles to growth or to increase the proliferative forces within the cell.

It appears to me by no means an easy matter to decide in all cases in which of the two ways mentioned cell-proliferation is brought about. Removal of obstacles to growth, not only in the way indicated by Weigert, but also by other disturbances in the neighborhood relations of the part, and very probably by the presence of definite chemical substances, may be the explanation of all pathological cell-growths. Certainly it would not be easy conclusively to disprove this view. Nevertheless, I fail to comprehend the inherent difficulties which some find in admitting the possibility of forms of energy, acting from without, directly increasing the formative energy of the cell; in other words, directly stimulating the cell to growth and multiplication. If such a possibility be admitted, the natural interpretation of some examples of cell-proliferation is that they are directly caused by the action of external forces, in the sense advocated by Virchow.

Students of the problems of pathological cell-growth must take into consideration not only the facts of human and allied pathology, but also those which are so rapidly accumulating in the domain of experimental embryology and morphology, to the importance of which I have repeatedly referred in this address. I would call attention especially to the observations from this source as to the influence of various changes of environment, particularly of definite chemical, thermic and mechanical changes in surrounding parts, upon the direction of movement and growth of cells. The use at present made of chemotactic phenomena in explaining the direction of movement of cells in human pathological processes is only a very limited and inadequate application of these important observations concerning tactic and tropic stimuli. We shall come to realize more and more the operation of these factors in determining cell-movements and cell-growth in human pathology. We already have evidence that different kinds of leucocytes not only possess different specific functions, but also respond in different ways to definite tactic stimuli. The long-standing problem

of the lymphoid cell in inflammation approaches solution along these lines of investigation.

A burning question, and one of perennial interest, relating to our subject is: How far are we justified in regarding acute inflammation as an adaptive or protective morbid process? There is fair agreement as to the essential facts of observation, but regarding their interpretation there are wide differences of opinion, and when one considers the complexity of the process and its still unsolved riddles it is not hard to see why this should be so. Much depends upon the point of view, and in this respect there can be recognized a certain antagonism between the purely clinical and the purely pathological and experimental views, an antagonism, however, which must be reconciled by a full knowledge of the subject.

It is not likely that the purely clinical study of inflammation would ever lead to the idea that the general tendency of this process is advantageous to the patient. The more severe and extensive the inflammatory affection, the more serious, as a rule, is the condition of the patient. The surgeon sees his wounds do well or ill, according to the character and extent of inflammatory complication. Measures directed to the removal of inflammatory exudation, such as the evacuation of pus from an abscess or an empyema, are the most successful methods of treatment, and their rules are embodied in ancient surgical maxims. How can one conceive of any purpose useful to the patient served by filling the air-cells of his lungs with pus-cells, fibrin and red corpuscles in pneumonia, or bathing the brain and spinal cord in serum and pus in meningitis? If nature has no better weapons than these to fight the pneumococcus or meningococcus, it may be asked, "What is their use but to drive the devil out with Beelzebub?"

But the pathologist and bacteriologist sees another aspect of the picture. An infectious micro-organism has invaded the tissues, where it multiplies and where its toxic products begin to work havoc with the surrounding cells, and by their absorption to cause constitutional symptoms and perhaps damage to remote parts. Is the destructive process to go on without any defense on the part of the body? There are attracted to the injured part an army of leucocytes from the bloodvessels, and perhaps other cells from the neighboring tissues, and it has been conclusively shown that these cells can pick up foreign particles and remove them, and that they contain substances capable of destroying many micro-organisms. At the same time serum accumulates in and around the injured area, and this may aid in destroying bacteria by its chemical properties, in diluting poisons, in flushing out the part. Fibrin may appear, and some think that this may serve in some situations as a protective covering. If these agencies, hostile to the invading micro-organisms, gain the upper hand, the débris is cleared away by phagocytes and other means, and the surrounding intact cells, which had already begun to multiply, produce new tissue which takes the place of that which had been destroyed. The victory, however, is not always with the cells and other defensive weapons of the body. The struggle may be prolonged, may be most unequal, may cover a large territory, and the characters and the extent of the inflammation furnish an index of these different phases of the battle.

Such in bald outlines are two divergent views of acute inflammation.

I do not see how we can fail to recognize in that response to injury, which we call inflammation, features of adaptation. Inflammation may be in some cases the best response to secure the removal or destruc-

tion of injurious agents, but we cannot look upon it as the most perfect mode of protection of the body against invading micro-organisms. One may inoculate into three animals, even of the same species, but possessed of different individual resistance, the same quantity of the same culture of a pathogenic micro-organism and obtain sometimes the following results: The first one will present no appreciable inflammatory reaction whatever and no evidences of any other disturbance, and examination will show that the micro-organisms have quickly disappeared. The second one will develop an extensive local inflammation and survive, but after a long illness. The third one will offer little resistance to the micro-organism, which rapidly multiplies without causing marked inflammation, invades the blood or produces toxæmia, and quickly destroys the life of the animal. Now, it is evident that the best protective mechanism is that brought into action by the first animal, but that the inflammatory reaction set up in the second one is better than the absence of reaction and of other defenses in the third animal.

I can scarcely do more on this occasion than to indicate some of the points of view from which it seems to me that we can best approach the study of inflammation as an adaptive process. With inflammation, as with other adaptive processes, any useful purpose subserved affords no explanation of the mechanism of the process. We should guard against all ideas which introduce, even unconsciously, the conception of something in the nature of an intelligent foresight on the part of the participating cells. The response of these cells in inflammation is a necessary and inevitable one determined by their innate properties. Our efforts should be directed, in the first place, toward as near an approach as possible to a mechanical explanation of inflammatory processes by a study, on the one hand, of the properties and mode of action of the causes of inflammation, and, on the other hand, of the nature and source of the cellular properties concerned. We may properly inquire whether these properties fit the cells to counteract the effects of injury, and if so, whence comes this fitness. Has the fitness those attributes of relative perfection which we find in most physiological adaptations, or is it characterized by the uncertainties and imperfections of so many pathological adaptations? Is the character of the response to injury in inflammation such as to indicate that the agencies concerned have acquired through evolutionary factors a special fitness to meet the pathological emergencies? Are all or only a part of the manifestations of the inflammatory processes adaptive?

It cannot be doubted that there are innate properties of certain cells called into action in inflammation, such as those manifested in the attraction of leucocytes and other cells by definite chemical substances, the capacity of cell-proliferation from causes connected with injury, the power of phagocytosis and other bactericidal properties, which may be adapted to counteract the effects of injurious agents. When these forces bring about the prompt destruction or removal of the injurious substances, and the defect is quickly repaired, the adaptation is complete and unmistakable. When, however, the inflammatory irritants and their destructive effects persist, and the proliferation of cells and accumulation of inflammatory products become excessive and occupy large areas, the features of adaptation are not so easily recognized. The mere occupation of territory by inflammatory products is often a serious injury, and it can be regarded as an adaptive feature only when they fill some artificial defect. Such occupation may be in itself enough to counteract any useful work in which these products may be engaged.

We can reasonably seek, in the relations of the body to the outer world, an explanation of the development of certain properties of cells which serve a useful purpose in mechanical and other injuries. These properties find application also in the normal life of the organism. Their exercise in response to injury imparts to inflammation important adaptive or protective characteristics, but I fail to see in this process any such special fitness as would justify extravagant statements which have been made to the effect that inflammation ranks among the adaptations of living beings by the side of digestion and respiration.

I have endeavored in this address to present certain general considerations concerning pathological adaptations. It has been possible to bring under consideration only a small part of an immense field, and this very inadequately. We have seen that in the sense in which adaptation was defined we can recognize in the results of morbid processes frequent and manifold evidences of adjustment to changed conditions. These adjustments present all degrees of fitness. Some are admirably complete; more are adequate, but far from perfect; many are associated with such disorder and failures that it becomes difficult to detect the element of adaptation. The teleological conception of a useful purpose in no case affords an explanation of the mechanism of an adaptive process. I have suggested that the adaptability of this mechanism to bring about useful adjustments has been in large part determined by the factors of organic evolution, but that in only relatively few cases can we suppose these evolutionary factors to have intervened in behalf of morbid states. For the most part the agencies employed are such as exist primarily for physiological uses, and while these may be all that are required to secure a good pathological adjustment, often they have no special fitness for this purpose.

The healing power of nature is, under the circumstances present in disease, frequently incomplete and imperfect, and systems of treatment based too exclusively upon the idea that nature is doing the best thing possible to bring about recovery or some suitable adjustment, and should not be interfered with, rest often upon an insecure foundation. The agencies employed by nature may be all that can be desired; they may, however, be inadequate, even helpless, and their operation may add to existing disorder. There is ample scope for the beneficent work of the physician and surgeon.

William H. Welch.
Johns Hopkins University.

THE NAPLES ZOOLOGICAL STATION.

The Naples Zoological Station celebrated with adequate ceremonies on April 14th its twenty-fifth anniversary. The exercises of the day began at 10 o'clock in the morning by a delegation representing the students at work in the Station calling upon Dr. Dorhn and expressing to him their appreciation of the privileges which the Station afforded them. This delegation consisted of representatives of the German, Italian and English-speaking peoples, each short and pointed address being delivered in the language of the representative. Dr. Dohrn happily replied, beginning his speech in German, continuing it in Italian and closing it in English. This delegation then waited upon Dr. Hugo Eisig, who has, from the beginning, been Dr. Dohrn's first assistant.

Early in the day the entire Station fleet was anchored in the bay near the Station. This fleet consists of two small steamers, the *Johannes Müller* and the *Frank Balfour*, and six small fishing boats. In the midst of this small fleet was anchored the second-class cruiser *Fieramosca*, sent by the Italian government to do honor to the occasion.

At 2 p. m. all at present connected with

the Station, together with many friends and distinguished visitors, assembled in the lecture room of the Station to listen to the speeches prepared for the occasion. The room was beautifully and appropriately decorated. On each side of the speaker's stand were tables containing telegrams, letters and other documents conveying greetings and congratulations to Dr. Dohrn.

The speeches were delivered in German and Italian. The opening address was by Professor Todaro, of Rome, who was followed by Professor His. The latter gave some account of the history of the Station, emphasizing its usefulness in advancing biology. He was followed by Professor Waldeyer, of Berlin, who brought an address from the Berlin Academy of Sciences, and who mentioned with some feeling of pride that he was one of the first students in the Zoological Station, when its resources were small as compared with what they are to-day. The Syndic of Naples then presented Dr. Dohrn with the freedom of the city. The audience was then favored with a short address by Admiral Palumbo, Under Secretary of State, after which the Minister of Public Instruction presented Dr. Dohrn the 'Grand Ufficiale della Corona d'Italia,' and brought the congratulations of King Humbert.

The closing speech was made by Dr. Dohrn, who delivered it in German. This address was printed in Italian and copies distributed to members of the audience. Dr. Dohrn spoke pleasantly of the people of Naples and the many privileges given him by the city, making special mention of Professor Panceri, whose influence made it possible to place the Station in the beautiful park known as the *Villa Nazionale*. To the Italian and German governments he expressed his gratitude for the sympathy and aid the Station had received from these sources. On the strength of a petition signed by Helmholtz, Virchow and DuBois-Reymond, the German Parliament granted to the Station an annual subsidy which has increased to about $10,000 per year. The Academy of Sciences in Berlin, the British Association for the Advancement of Science and the Smithsonian Institution were mentioned for their aid in maintaining several tables in the Station.

Dr. Dohrn referred with much feeling to the assistance given him by his father and also the father of Mrs. Dohrn, during the early years of the Station's history. Much credit was given to Mrs. Dohrn, who always gave her sympathy and aid to the interests of the Station. The money given her by her father to furnish her house was used to assist in maintaining the Station during the critical period of its history. Much praise was also given Hugo Eisig, who when a very young man cast his lot with Dr. Dohrn, and long before the Station was an assured success. His ability, energy and kind cooperation have contributed largely to make the Station what it is to-day.

After the exercises were over the students in the Station were taken on board the man-of-war. In the evening Dr. and Mrs. Dohrn entertained the distinguished visitors at tea, and thus ended one of the most pleasant and eventful days in the Station's history. On April 17th the students of the station gave Dr. and Mrs. Dohrn a dinner at Fusaro.

During the day the writer heard Dr. Dohrn express his delight at the success and usefulness of the Station; that while its present condition was all one could wish, his hope and aim was to see it placed on such a foundation that its future usefulness would be assured. It was with a feeling of pride that we listened to him refer so kindly to an American lady who had just written him that she was succeeding nicely in securing funds with which to endow a table in the Station.

The usefulness of the Station is so well

known to American biologists that it is useless for me to add anything in the way of a detailed description of its internal management, and yet this little account would seem very incomplete without some mention of Dr. Lo Bianco, whose knowledge of the plants and animals in the Bay of Naples, and whose skill in capturing animals and preparing them for study and for museum use is remarkable.

At present two tables in the Station are supported by American institutions (Columbia University and the Smithsonian Institution), but these are inadequate to meet the demands of American students who wish to make use of the Station's privileges. Thanks are due Dr. Dohrn, who always makes room for deserving American students when it is possible for him to do so. At one time during this year there were seven Americans in the Station; at present there are four. I believe I voice the sentiments of all Americans here at present, and those who have been here in the past, when I express the wish that provisions be made by Americans or American institutions for American students wishing to study here.

S. E. Meek.

Naples.

ZOOLOGICAL SOCIETY OF LONDON.

The sixty-eighth Anniversary Meeting of this Society was held on April 29th. After some preliminary business the Report of the Council on the proceedings of the Society during the past year was read by Mr. P. L. Sclater, F. R. S., the Secretary. It stated that the number of Fellows on the 1st of January, 1897, was 3,098, showing a net increase of 71 members during the year 1896. The number of new Fellows that joined the Society in 1896 was 207, which was the largest number of elections that had taken place in any year since 1877.

The total receipts of the Society for 1896 had amounted to £27,081 which was £123 more than the very successful year, 1895. The ordinary expenditure had amounted to £23,788 which was an increase of £327 over that of the year 1895. Besides this a sum of £2617 had been paid and charged to extraordinary expenditure, of which amount £2600 had been paid on account of the construction of the new house for ostriches and cranes. A further sum of £1000 had also been transferred to the Deposit Account, leaving a balance of £1066 to be carried forward for the benefit of the present year.

The usual scientific meetings had been held during the year 1896, and a large number of valuable communications had been received upon every branch of zoology. These had been published in the annual volume of 'Proceedings,' which contained 1,110 pages illustrated by 52 plates. Besides this, parts 1 and 2 of the 14th volume of the Society's quarto 'Transactions' had been published in 1896. A new edition of the List of Animals, containing a list of all the specimens of the vertebrated animals that had been received by the Society during the past twelve years, had been published and issued to the subscribers to the publications in November last. The 32d volume of the 'Zoological Record' (containing a summary of work done by zoologists all over the world in 1895), edited by Dr. David Sharp, F.R.S., had been published and issued to the subscribers in December last.

The library, containing upwards of 20,000 volumes, had been maintained in good order throughout the year, and had been much resorted to by working naturalists. A large number of accessions, both by gift and purchase, had been incorporated.

The number of visitors to the Gardens in 1896 was 665,004, being 322 less than the corresponding number in 1895. This slight decrease was easily accounted for by

the unsettled state of the weather in the latter part of the past year.

The number of animals in the Society's Gardens on the 31st of December last was 2,473, of which 902 were mammals, 1,132 birds and 439 reptiles and batrachians. Amongst the additions made during the past year 18 were specially commented upon as of remarkable interest, and in most cases new to the Society's collections. Amongst these were a young male Manatee from the Upper Amazons, a young male Klipspinger from northeast Africa, a young female Gorilla from French Congoland, a pair of lettered Aracaris from Pára, a young Brazza's Monkey from French Congoland, a Loder's Gazelle from the Western Desert of Egypt, three Ivory Gulls from Spitzbergen and three Franklin's Gulls from America. A serious loss was occasioned to the Society's menagerie by the sudden death, in March last, of the male Indian Elephant (Jung Pasha), deposited in the Gardens by H. R. H. The Prince of Wales on his return from India in 1876, and for the past twenty years well known to all visitors to the Gardens.

A vote of thanks to the Council for their report was then moved by Dr. Henry Woodward, F.R.S, seconded by Lord Medway, and carried unanimously.

The report having been adopted, the meeting proceeded to elect the new members of Council and the officers for the ensuing year. The usual ballot having been taken, it was announced that William Bateson, Esq., F.R.S., Col. John Biddulph, Dr. Albert Günther, F.R.S., Osbert Salvin, Esq., F.R.S., and Joseph Travers Smith, Esq., had been elected into the Council in the place of the retiring members, and that Sir William H. Flower, K.C.B., F.R.S., had been re-elected President; Charles Drummond, Esq., Treasurer, and Philip Lutley Sclater, M.A., Ph.D., F.R.S., Secretary to the Society, for the ensuing year.

CURRENT NOTES ON ANTHROPOLOGY.

PRIMITIVE SYMBOLIC DECORATION.

Two articles have lately appeared which are worth a comparison. The one is by Mr. C. C. Willoughby, of the Peabody Museum, Cambridge, in the *Journal of American Folk-lore* for March, on the decorations upon pottery from the Mississippi valley. It is a recasting of that read by himself and Professor Putnam before the American Association in 1895. He points out a variety of simple designs which he identifies as 'cosmic symbols,' 'sun symbols,' others for the winds, the clouds, the bird, the band, etc. Of course, the svastika, the triskeles and the cross come in as other 'symbols.'

This is one view to take of the aim of primitive decoration, and it is now in the ascendant in the United States. But in France they think otherwise. In the *Bulletin of the Paris Anthropological Society* (1896, Fasc. 6) M. Regnault has an article on the beginnings of ornamental art among primitive peoples, in which he explains such figures as the natural result of crossing lines, joining angles, repeating designs, connecting curves, etc., all this in the most simple manner and without any occult or mystic intent whatever. They were mere decorative sketches, 'only this and nothing more.'

It is easy to read into barbaric scratches the thoughts of later times, and we must acknowledge that something more besides the figure itself is needed to prove its symbolic sense.

MAN'S SPEECH TO BRUTES.

A PRIMITIVE myth asserts that in the good old times men and brutes conversed together understandingly. How limited their intercourse by speech now is may be learned from Dr. H. Carrington Bolton's paper in the *American Anthropologist*, 'The language used in talking to Domestic Animals.'

He has collected numerous specimens from various countries, and reaches some interesting conclusions. Thus it appears that the terms used in calling animals are generally corruptions of their names, and usually the expressions addressed to them are from the language of the place. Certain inarticulate sounds, as the click, used with us to start horses, and the chirp, uttered to hasten their pace, are in vogue in remote lands also, as in India, but with a reverse meaning. Even between France and Switzerland such examples of counter-sense are quoted. This illustrates that the adoption of these sounds is purely conventional, and the only curious feature remains that the same sound is repeated in widely different localities. There is also evident an unconscious attempt on the part of man to lower his language to the comprehension of the brute by abbreviations.

D. G. Brinton.
University of Pennsylvania.

ASTROPHYSICAL NOTES.

The Harvard Observatory makes an important contribution to astrophysics in Part I. (pp. 1–128) of Vol. XXVIII. of its Annals. This contains a discussion, by Miss A. C. Maury, under the direction of Professor E. C. Pickering, of the spectra of the brighter stars photographed with the eleven-inch Draper telescope. This laborious investigation has involved the examination of nearly five thousand photographs of 681 stars north of 30° south declination, and has been in progress for several years. From one to four prisms were placed before the object-glass, and the length of the photographed spectrum, between the hydrogen lines β and ϵ, was from 2 to 8 cm. accordingly.

A scheme of classification was outlined by Miss Maury, containing 22 groups of spectra, with three 'divisions,' *a*, *b* and *c*, into which each group might be subdivided according to the appearance of the lines present in it. The groups are presumed to represent in some degree successive stages of stellar development, I to V containing spectra of the Orion type (Vogel's II *b*), while groups VII to XI, XIII to XVI, and XVII to XX respectively include Secchi's first, second and third types. VI and XII are considered as transitional groups. Group XXI is Secchi's type IV, and XXII is Pickerings fifth type—bright-line stars and planetary nebulæ. Typical stars of each group are cited, and about forty pages are given to a detailed description of the characteristics of each group. The desirability of the introduction of a new classification of stellar spectra may be open to question, but there can be no doubt that the results of minute study of spectra must be expressed in some systematic way, since gradations of spectra are perfectly evident. Miss Maury is quite justified in thus systematizing her work, as she has done without undue reference to theories of development. It is, however, hardly to be expected that this classification will be generally adopted. The time has not yet come for general agreement on stellar classification. Further laboratory researches and theoretical investigations upon luminescence must be awaited before stellar spectra can be interpreted.

Separate chapters are devoted to the Orion lines;* to the solar lines between λ 3686 and λ 5896 with their occurrence and intensity in the stars, to the lines in stars of division *c*, and to the relative intensities of lines. Chapter VIII. contains a table of the stars in their order by groups and subgroups or divisions, followed by several pages of valuable notes on individual stars. Chapter IX. is a general catalogue of the stars investigated, in order

*The identification of these lines with those of heilum was discovered too late for discussion until the close of the volume.

of right ascension, with assignment to group and reference to the numbers of the plates.

The tabular form of statement of results, which has become rather characteristic of the Harvard Annals, is followed in this volume. It is sometimes doubtful whether the compactness thus gained compensates for the difficulty of understanding the tables without minute study of them—a difficulty especially felt by foreigners. The notes on individual stars would be more convenient if the name of the star had been used, besides the reference number.

Although the quantitative accuracy of the spectrograph cannot be expected of the objective-prism, yet it seems adequate for the purposes of the volume under review. The objective-prism alone could collect such treasures of information as are included in the vast number of photographs stored in the Harvard Observatory and drawn upon in successive annals.

THE *Atlas der Himmelskunde*, of which the first of its thirty parts is at hand, is chiefly devoted to the reproduction of recent astronomical photographs. The author, A. von Schweiger-Lerchenfeld, has had the assistance of numerous astronomers and instrument makers in preparing this work, which promises to fully represent—especially by its five hundred excellent engravings and half-tones—the instruments and results of modern astro-photographic research. (Wien und Leipzig, A. Hartleben's Verlag.)

E. B. F.

CURRENT NOTES ON METEOROLOGY.

RECENT ARTICLES ON KITE-FLYING.

THE rapidly increasing interest that is being taken in kite-flying is shown by the fact that the May number of the *Century Magazine* contains three articles on the subject. The first, by J. B. Millet, the only one which deals more particularly with the meteorologic aspect of the matter, is entitled *Scientific Kite-Flying* and presents the general facts regarding the different forms of kites and the methods of work and the results obtained at Blue Hill Observatory. The second article, *Experiments with Kites*, is by Lieut. Wise, of the U. S. Army, and describes the experiments made by him at Governor's Island, New York Harbor, with an account of the ascent of January 22, 1897, on which day Lieut. Wise was lifted 42 feet from the ground by means of four kites. The last article, by W. A. Eddy, on *Photographing from Kites*, concerns the experiments made with a camera carried up by kites and also gives an account of the first telephoning and telegraphing through a line held by kites. All the articles are illustrated and will undoubtedly attract considerable attention. Although kites can be used for many purposes, the interest that meteorologists have in kite-flying is limited chiefly to the possibility of elevating self-recording instruments to considerable heights above sea level by this means. It is this exploration of the free air by means of meteorographs sent up on kite lines which has been so actively and so successfully carried on at Blue Hill Observatory, as already stated in these Notes.

DEFORESTATION AND CLIMATE.

CLIMATIC descriptions contain frequent allusions to the supposed influence of deforestation on climate, although we have not as yet enough reliable meteorological data to warrant our holding any definite opinion as to this influence one way or the other. In a lecture on the diamond mines of Kimberley, delivered at the Imperial Institute, London, on November 16th last, and reported in a recent number of *Nature* (April 1), Dr. Wm. Crookes, F. R. S., referred to the deforestation which has been going on around Kimberley and to the change in climate which is believed to have resulted from this deforestation. It is reck-

oned that over a million trees have been cut down to supply timber for the diamond mines, and the whole country within a radius of 100 miles has been denuded of wood, with the most injurious effects on the climate, as is generally believed there. The absence of trees to break the force of the wind and temper the heat of the sun, combined with the extreme dryness of the air, is thought to account for the dust storms so frequent in that region in summer.

ACCLIMATIZATION OF THE ENGLISH IN CEYLON.

In connection with the acclimatization of Europeans in the tropics, to which reference was recently made in these Notes, a statement made by a recent writer on Ceylon, who was for many years Judge of the Ceylon Supreme Court, may be of interest. The quotation, which is from an article in the *Scottish Geographical Magazine* for April, is as follows: "When all is said, in a tropical climate, even of the best, we live, as it were, on sufferance, and the climate tells on the next generation. For every one of us who has his livelihood in Ceylon there comes the inevitable day when he must part from his children and send them home. This stern necessity has been styled a price which we must pay our Eastern possessions; and a heavy price it is." The pathetic strain of such a statement serves to emphasize anew the lesson that complete acclimatization of northern Europeans in the tropics is impossible.

RECENT PUBLICATIONS.

F. H. Bigelow: *Storms, Storm Tracks and Weather Forecasting.* Bulletin No. 20. United States Department of Agriculture, Weather Bureau, 8 vo., Washington, 1896. Pp. 87. Charts 20.

I. H. Cline: *Influence of Climatic Conditions and Weather Changes on the Functions of the Skin.* Reprinted from Proc. Texas State Medical Association, 1896. Pp. 8. Chart showing the pathological distribution of climate in the United States.

R. De C. Ward.

Harvard University.

SCIENTIFIC NOTES AND NEWS.

The University of Toronto has conferred the degree of LL.D. on Sir John Evans, President of the British Association for the Advancement of Science; on Dr. Wolcott Gibbs, President of the American Association for the Advancement of Science, and on three of the most distinguished English men of science, who are expected to attend the Toronto meeting of the British Association: Lord Lister, Lord Kelvin and Lord Rayleigh.

The third annual meeting of the Botanical Society of America will be held in Toronto on Tuesday and Wednesday, August 17th and 18th, 1897, under the presidency of Dr. John M. Coulter. The Council will meet at 1 p. m. on Tuesday, and the first session of the Society will begin at 3 p. m. The address of the retiring President, Dr. Charles E. Bessey, will be given on Tuesday evening at 8 o'clock. The British Association for the Advancement of Science will meet in Toronto, August 18th to 25th. The opening address is to be given on Wednesday evening, August 18th. A fairly large contingent of British botanists and some Continental botanists of note are expected. This meeting will, therefore, probably give unusual opportunities for renewing or forming acquaintances. All foreign botanists present will be invited to sit as associate members of the Society and to read papers. This invitation will be addressed personally to all whose intention to come to Toronto is known, and will also be made known through the scientific papers.

Miss Catherine W. Bruce, of New York City, has again shown her great interest in astronomy by sending Professor J. K. Rees, Director of the Columbia University Observatory, a check for fifteen hundred dollars ($1,500). The money is to be used in publishing the observations and reductions for 'Variation of Latitude and the Constant of Aberration,' made by Professors Rees and Jacoby and Dr. Davis. To this fund for publication there had been

contributed previously a donation of one hundred dollars ($100) by Mrs. Esther Herrman, of New York City. Mrs. Herrman's interest in scientific matters has been evidenced by many generous gifts to the New York Botanical Gardens, the New York Academy of Sciences, etc. The intelligent interest of women in all original work in science has been exhibited abundantly in the past few years, and astronomy especially has been generously aided by the contributions of such women.

HENRY G. BRYANT, of Philadelphia, accompanied by S. J. Entrikin and E. B. Latham, has started for Alaska for the purpose of climbing Mt. St. Elias and making explorations in the adjacent region. Mr. Bryant, as is well known, has had experience in exploration in Labrador, and has made summer trips to Greenland. Mr. Entrikin was with Peary in Greenland and made an expedition over the inland ice. Mr. Latham is a member of the U. S. Coast Survey, and goes equipped for geographical work. The party will be increased by three or four camp hands in Seattle, and will establish a base camp on the west shore of Yakatat Bay early in June. Their plan is to cross the Malaspina glacier to the Samovar Hills; from there ascend the Agassiz glacier, and thence up the Newton glacier to the divide between Mt. Newton and Mt. St. Elias. A camp will be established on the divide, elevation about 13,000 feet, from which the ascent to the summit of Mt. St. Elias will be made. On returning to the Samovar Hills the explorations will be continued westward through an entirely unknown region until a pass is discovered which will enable the explorers to cross the St. Elias Mountains and gain one of the branches of Copper River. The return to the coast will be by way of Copper River. The party is well equipped and has every prospect of success.

DR. E. J. STONE, F.R.S., the well-known astronomer, Radcliffe Observer, at Oxford, died on May 9th. Mr. A. D. Bartlett, Superintendent of the London Zoological Society's Gardens, died on May 7th at the age of 85. He had contributed many valuable papers to the meetings of the Society. Mr. Legrand Des Cloizeau, formerly professor of mineralogy at the Paris Museum of Natural History, member of the Section of Mineralogy of the Paris Academy, died on May 8th, aged 79 years. Mr. Theodore Bent, known for archæological and geographical explorations, died on May 5th from the effects of malarial fever, contracted while carrying out explorations in Arabia.

AMONG the deaths at the fire in the Paris Charity Bazaar was that of Dr. Feulard, a well known student of dermatology. He had taken his wife out of the building and was killed while returning to rescue others.

MR. F. D. GOODMAN, F.R.S., has been elected President of the British Ornithologists' Union.

THE custodianship of the Great Serpent Mound in Adams county, Ohio, has been transferred by the Peabody Museum of Harvard University to the Ferris Memorial Library of Madisonville.

THROUGH the influence of President David Starr Jordan arrangements have been made for the establishment of zoological gardens in San Francisco.

THE report of the committee of the National Academy of Sciences on a forestry policy for the United States was ready on May 1st, but has been delayed in printing. It is now expected, however, that the complete report will be sent at once to Congress by President McKinley.

THE twenty-sixth Congress of the German Surgical Society was held at Berlin from the 21st to the 24th of April. It appears from the account in *Die Natur* that special attention was given to the applications of X-rays to surgery.

IN addition to the Section of Nervous and Mental Diseases of the International Medical Congress at Moscow, there is to be held an International Congress of Neurology, Psychiatry and Medical Electricity and Hypnotism, from the 16th to the 19th of September, in connection with the Brussels International Exposition. The English program for this Congress is sufficiently curious to deserve quotation. Among the questions submitted for special discussion are: 'Influence of the Delivery on the Nervous and Mental Diseases presented later by Children,' and 'The Question of Criminal Suggestions: its Origins and Actuel State.' Among

items given under 'Advice' are "The personal communication may not dure longer as twenty minutes unless the President finds that the duration may be prolonged," and "Independently of the questions treated by the reporters, members are authorized to do personal communications."

In connection with the International Medical Congress at Moscow a two weeks' excursion has been arranged to the Caucasus, visiting the celebrated mineral baths of which Kislovodsk is the center and traversing the region notable for its fine scenery. The members of the Congress will be charged only thirty dollars for transportation and for sleeping accommodation on the trains and steamboats.

At the Child-study Conference held recently at Chicago a North American Child-study Association was formed with the object of establishing State Societies and promoting the interests of the work.

Mrs. Ellen B. French has bequeathed $5,000 to Beloit College on condition that no vivisection shall ever be practiced there. Should this condition not be accepted the money goes to the American Humane Society of Boston.

The last of the public lectures of the present year before the New York Academy of Sciences will be delivered this evening by Dr. Harwood Huntington, his subject being 'The Technology of Cotton Cloth.'

The Swiss Zoological Society, founded in 1894, has undertaken to prepare a *Fauna Helvetica*. Preliminary studies are being encouraged with this end in view and are published in the *Revue Suisse de zoologie*, edited by Dr. Bedot.

There is to be held, in conjunction with the Brunswick meeting of German men of science and physicians, an exhibition of scientific objects and instruments. It is expected to make the exhibit in scientific photography especially complete, this year being the first in which that subject is represented by a special section.

It has been the custom at the annual meetings of the British Medical Association to have an exhibition of pathological and anatomical specimens, and of apparatus more especially connected with the teaching and demonstration of anatomy, physiology and pathology. This year the Museum will be held in the dissecting room at McGill University, where ample accommodation and light is afforded to demonstrate the specimens to every advantage, while, to further aid the exhibition, a special grant has been obtained from the general committee. It is suggested that a special feature of the year's exhibit should be a collection of photographs and micro-photographs, illustrating interesting abnormalities of any kind whatsoever.

An observatory is to be established at Odessa as a branch of the observatory at Pulkowa.

The lenses for the great telescope of the Yerkes Observatory were shipped from Cambridge on May 17th on a special parlor car, in the care of Mr. Alvan G. Clark and two assistants.

The Anatomical Society of Great Britain and Ireland will hold its annual summer meeting on June 10th and 11th. An evening address will be given by Professor His, of Leipzig.

Nature states that the Geological Commission of Cape Colony has published a bibliography of South African geology, containing a list of nearly 600 papers.

The Berlin Academy of Sciences has granted Professor Paschen, of Hanover, M. 1,100 for experiments on the energy of the spectra of dark bodies, and M. 1,000 to Dr. Hertz for the reduction of observations from the Kuffner Observatory.

We learn from *Nature* that the Committee of the Puffin Island Biological Station have decided to offer facilities to students and others for the pursuit of scientific research at the Station during the summer months. The island is well situated for the study of both marine zoology and ornithology, and the Station is provided with sleeping accommodation in addition to the usual laboratories. Those wishing to avail themselves of the present opportunity should communicate with the Director, Professor P. J. White, University College of North Wales, Bangor.

The Italian correspondent of *The Lancet*

writes of the destruction of Captain Bóttego while engaged in exploring the basins of the Gava and of the Omo, the regions between the Nile and Lake Rodolfo. Captain Bóttego left Brava in the Benadir on October 12, 1895; reached Lug on November 18th, founded the station, started on December 27th with 180 men along the Ganane and the Gava, and kept the Geographical Society informed of his successes till April 22, 1896, when it forwarded him news of the disasters in Abyssinia. The bearer of this reached Lug in May and started in quest of the expedition. Meanwhile indirect news of Captain Bóttego and his column as late as October last represented him as having gained the south shore of Lake Rodolfo on his return journey, and further tidings reached London that he was making for the coast of the Indian Ocean, till on April 23d King Menelik received a despatch announcing that on the Ethiopian frontier towards Baro Captain Bóttego had come into conflict with a native tribe and had been killed, that two other Italians were made prisoners, and that the fourth Italian member of the expedition had not been heard of. Whether this is the medical officer, Professor Maurizio Sacchi, an able naturalist, is not yet known.

WE have already called attention to the International Congress of Mathematicians to be held at Zurich. According to the *Bulletin of the American Mathematical Society* the local committee announces the following general program: Meetings of the entire Congress will be held on Monday, August 9th, and Wednesday, August 11th, at which questions of a more general character will be discussed. Papers dealing with special subjects will be presented before the various sections on Tuesday, August 10th. The Congress will direct its attention not only to purely scientific questions, but also to matters of an executive and business nature, such as questions of bibliography, lexicography, terminology, cooperative scientific undertakings, including historical investigations, comprehensive reports, the publication of treatises, the holding of expositions, etc.

AN article in a recent issue of the London *Times* advocates the renewal of Antarctic exploration under the auspices of the British government. Belgium will send out an expedition next September to the neighborhood of the Antarctic, but it will be a small one and will devote itself mainly to oceanographic work in the vicinity of Graham's Land. There has been some talk of a German expedition, but the collection of the necessary funds seems to be making slow progress. It is estimated that the cost of an expedition need not exceed £50,000. The writer of the article says that there is reason to hope that, if the Government decides not to intervene, the Royal Geographical Society is prepared to attempt to organize an expedition to the Antarctic and so save the credit of England. It was primarily at the instigation of this Society that Ross's expedition was sent out over half a century ago, and many other expeditions hardly less formidable have been equipped under the auspices, and partly or wholly at the expense, of this Society. Obviously in this case, however, the funds required are beyond its means. But there can be little doubt that, if the Society is in earnest about an Antarctic expedition, there are men able and, if appealed to in the right way, willing to follow the brilliant example set by Mr. Harmsworth. Under its present able, energetic and enthusiastic President, Sir Clements Markham, the Society need not hesitate to enter upon this enterprise. Moreover, it is impossible not to believe that the Government, if once the enterprise were fairly started, would lend its aid in one shape or another.

THE May number of the *Engineering Magazine* contains an account taken from French technical journals of the *Société des Ingénieurs Civils de France* and its new building. The Society was organized in 1848 with a membership of 134. The membership now reaches a total of 2,724, and the Society stands as one of the leading professional organizations of Europe. Its monthly transactions, '*Memoires et compte rendu des travaux de la Société des Ingénieurs Civils de France*,' are everywhere recognized as the record of the best work of French engineers, and membership in the Society is an acknowledged mark of professional eminence. A new building has been recently constructed for the

use of the Society in Paris, the dedication ceremonies having taken place on January 14th, President Faure assisting. The cost of the building alone was $100,000, to which must be added the cost of the ground, $80,000. On the ground floor is the large meeting room, which, including the communicating conversation room, measures 72x49 feet, and is of interest because of the peculiar construction of the floor, whereby it may be mechanically lowered at the platform end and thus in a few minutes be converted into a sloping hall for meetings. The upper floors, in addition to offices, committee rooms, etc., contain ample room for the valuable library, a laboratory, a photographic room and the residence of the General Secretary. The building was constructed in the short space of nine months from designs by Professor Delman, in the style of architecture of Louis XIV.

It is stated in the *British Medical Journal* that a professor of the Paris Natural History Museum accidentally discovered an entrance into subterranean passages running underneath the Jardin des Plantes and a part of the Boulevard Saint-Marcel. The archives of the Museum furnish proof that these galleries were constructed by the Romans; in the fifteenth and eighteenth centuries they were repaired and consolidated, and are now in perfect order. Nothing is known as to the purpose they served. M. Armand Viré, a corresponding member of the Museum, asked for permission to use the passages as a laboratory for researches on animal life inhabiting caverns, and studying the successsive phases in the transformation of these degenerate forms of life, and the laboratory was inaugurated a few days ago. M. Viré, followed by fifty invited guests, bareheaded and stooping, each carrying a candle, traversed the labyrinth of galleries until they reached a round hall, the roof of which is supported by a stone column. This is the principal laboratory. It contains stone tables with perfectly flat surfaces. The water supply is assured by a good system of pipes. Seine water was in the first instance used, but the animals died. They were replaced by others, which were given spring water and are in a flourishing condition.

UNIVERSITY AND EDUCATIONAL NEWS.

Cambridge University rejected, on May 21st, the proposal to confer degrees upon women by a vote of 1,713 to 662.

A committee of the Board of Trustees of the College of the City of New York has recommended that eight assistants be appointed to assistant professorships, with salaries from $2,500 to $3,500, according to term of service. The promotions are expected to include Charles A. Doremus, chemistry and physics; Ivan Sickles, natural history; and Gustave Legras, J. R. Sim and C. R. Smith, mathematics.

Miss Mary Cloyd Burnley, of Swarthmore, Penn., who will receive the degree of B.A. from the Woman's College of Baltimore in June, has received the fellowship in chemistry from Bryn Mawr College for next year. Miss Burnley also receives a summer scholarship in biology at the Marine Biological Laboratory at Wood's Holl, Mass., from the Woman's College.

Dr. Frech has been promoted to a full professorship of geology in the University of Breslau, Dr. Carl Paal to a full professorship of pharmaceutical and applied chemistry in the University of Erlangen, and Dr. Raphael Freiherr v. Erlanger and Dr. Paul Samassa to associate professorships of zoology in the University of Heidelberg. Dr. Bredt, of Bonn, has been made full professor of chemistry in the Polytechnic Institute at Aix, and Professor Franz Meyer, docent in mathematics in the School of Mines at Klausthal, has been called to the University of Königsburg.

A special course in paleontologic geology will be given by Mr. Stuart Weller at the University of Chicago during the summer quarter beginning July 1st. The course will be devoted to the laboratory study of fossil invertebrates. Its aim will be to give instruction and training in the identification of fossils and in the interpretation of fossil faunas. The work will be entirely individual in its character and will be adapted to the special wants and needs of each student. The offering of the course is experimental and its repetition will depend upon the demand which may be found for it. There will accompany this a class-room course

in Geological Life Development by Mr. Weller. The usual courses in general and special geology will be given by Professor Salisbury during the first half of the summer quarter, followed by his field course during the second part.

MR. FRANCIS H. SCOTT writes us that the bill before the Legislature to change the name of the Michigan Mining School to the Michigan College of Mines became a law early in April, and the latter is now the proper name of the institution. The students and the people of the Upper Peninusula generally have accepted the new name gladly, considering it much more appropriate for the character of the work done in the institution. Another bill which has been pending for some time regarding the charging of tuition has been passed, fixing the rate at $25.00 for residents of Michigan, and not less than $50.00 or more than $200.00 for those residing outside of Michigan. The rate is under consideration and, in all probability, will be fixed at $150.00. This tuition fee will correspond with that charged by other first-grade technical schools in America, such as Columbia College School of Mines, the Rensselaer Polytechnic Institute, the Stevens Institute of Technology and the Massachusetts Institute of Technology. When the school was working out its policy, trying to solve its educational problems, it was thought wisest to charge no tuition, but to collect as wide a constituency as possible in order that there might be all possible chance to make the methods as broad and thorough as could be done. It was also deemed hardly just to the students educated here to demand tuition until the institution was much better equipped for its work than the appropriations granted during the first decade of its existence permitted. Now, that success has been attained in educating men for practical work, as is evidenced by the positions which its eighty-six graduates hold, as given in the last catalogue, the institution seems fully warranted in charging hereafter for its instruction. The new law goes into effect immediately after August 19, 1897, and will, therefore, not apply to students entering previous to that time. A prospectus will soon be issued by the College, giving the details of the regulations finally adopted by the Board of Control.

DISCUSSION AND CORRESPONDENCE.

DISTRIBUTION OF MARINE MAMMALS.

TO THE EDITOR OF SCIENCE: Without discussing the general questions treated in Dr. Sclater's paper in SCIENCE of May 14th, it may be well to call attention to some errors of detail.

Dr. Sclater credits the North Atlantic region (Arctatlantica) with the exclusive possession of the genera *Delphinapterus* and *Monodon* and the species *Balæna mysticetus*.

Monodon, though rare, occurs in the region of Bering Strait, while it is not known, as yet, to enter Bering Sea.

Delphinapterus is abundant in Bering Sea, often ascending the large rivers which fall into that sea. Specimens have been noted in the Yukon 600 miles from salt water.

Balæna mysticetus, though now nearly exterminated, was a short time ago the principal object of the whale fishery of the North Pacific, Bering and Okhotsk seas. During the early days of the whale fishery several well attested instances occurred of whales (*B. mysticetus*) struck in one ocean, as the Atlantic, being afterward killed in the North Pacific, and *vice versa*.

It may also be mentioned that less than ten years ago a herd of over 200 fur seal were noted on one of the Galapagos Islands and an expedition was fitted out to go there for the purpose of hunting them.

WM. H. DALL.

SMITHSONIAN INSTITUTION, WASHINGTON,
May 16, 1897.

A POSTSCRIPT ON THE TERMINOLOGY OF TYPES.

MR. LUCAS' remarks might have been more intelligible to me had they followed instead of preceded the lucid paper by Mr. Schuchert: 'What is a type in Natural History?' (SCIENCE, N. S., V., pp. 636–640, April, 1897.) To save further misapprehension, permit me to add that under 'type-specimens' I included 'holotypes,' and at all events the more important 'cotypes' and 'paratypes.'

This slight misunderstanding shows how necessary the definition of these terms has become. It also exemplifies a danger that needs constant guarding against, namely, the employment of a common word in a restricted or altered technical sense. The man in the street

knows the meaning of 'type' and 'typical,' but the meaning of those terms to the zoologist is something quite different. The scientific man is constantly hampered by the formalities of his science; and zoology is not advanced by the fact that the holotype, and perhaps the paratypes, of a species are often aberrant forms, *i. e.*, are *not* typical in the ordinary English sense. Of this no instances need be quoted.

Now while many individuals of a species may be typical (in the ordinary sense), we can conceive of one form, not necessarily existing, that represents a kind of central type, or, as I have expressed it elsewhere, a composite portrait of the species. It is this that is the 'type' of the man in the street. Instances of this are to be found in the statistical tables of Galton, Weldon, Bateson and others; a type-formula for *Ranunculus repens* was given by Pledge in *Natural Science* for May, 1897; but some of the most interesting are J. M. Clarke's studies of *Leptodesma* (*Amer Geol.*, April, 1894, and *Nat. Sci.*, June, 1894).

For this kind of type, far removed from a type-specimen, we want a name; and as the word type has been stolen from us it will save confusion to avoid it altogether. J. M. Clarke used 'fundamentum' as an alternative; but other American biologists attempted to use this as the equivalent of *Anlage*, while the fundament of man in the street is quite a different anatomical conception. Perhaps the word 'norm,' with its adjectival form 'normal,' would give the meaning most nearly, though 'normal has, of course, its more literal sense of 'at right angles to.' The norm of a species varies with locality or with horizon, becoming in the former case the norm of a subspecies, in the latter case the norm of a mutation. So also one can sometimes imagine the norm of a genus; and how very different a thing that would be from the type-species, at least of many genera! The genus-norm also may vary with locality. Thus the species of *Gissocrinus* in Gotland group themselves around *G. typus*, but those in England around *G. goniodactylus*.

This conception of the norm will probably be found at least as helpful as that of the 'hypoplastotype.' It would be of value if it did no more than draw our thoughts from the wearisome history of human error back to the facts of nature.

With reference to what Mr. Schuchert calls a 'plastotype,' but which I would as lief call a 'cast o'type,' or perhaps 'electr-o-type,' may I put to him the case of a cast made from a natural matrix which has subsequently been partly destroyed, in order to expose its inner recesses more fully or to admit of the extraction of the cast? Such a cast would preserve features that could never again be shown by the matrix, and might therefore find a place in the hierarchy labelled 'type material' by Mr. Schuchert.

Another question. When the holotype and paratypes of a species have gone the way of all flesh; when topotypes are impossible and metatypes unknown; when even its plastotypes are not to be had—then what are we to call the specimen selected for special description by the reviser and reestablisher of the species? Should it not be something distinct from the ordinary 'hypotype?' But this subject of hypotypes offers so wide a field for the neologist that prudence bids me cease.

F. A. Bather.
British Museum (Natural History).

'ORGANIC SELECTION.'

To the Editor of Science: In Science for April 23, 1897, J. Mark Baldwin submitted, in a paper headed 'Organic Selection,' an hypothesis which he implies to have originated 'in certain recent publications' by H. F. Osborn, C. Lloyd Morgan and himself in the year 1896. The hypothesis is based on the idea that characters acquired during the life of an individual are, to a considerable extent, those characters which cause the survival of that individual; or, in other words, that an organism which varies not only because of variations in the germ-cell, whence it evolves, but also because of the variety of forces acting on it while it is so evolving (especially after birth), and, on account of these variations, survives and reproduces at the expense of other organisms, must so survive partly on account of the one set of variations and partly on account of the other set. On this basis it is argued that, as connate characters in general persist, those particular connate characters which are identical with those acquired characters with which they coexist and to the virtue of which the survival of

the individual is in part due will persist in the next generation; and, furthermore, that there will arise, by like processes in successive generations, an accumulation of such connate characters. Hence, it is said there may appear to be an inheritance of acquired characters where, in reality, there is only an accumulation of connate characters identical with the acquired characters which, as it were, shield the connate characters while they are accumulating in successive generations.

My intention is not to discuss the merits of this hypothesis, but to say that, if I understand it, it is by no means new. It was clearly set forth by Herbert Spencer, in his 'Principles of Biology,' in the year 1866. Though it may have been presented by him or by others before that time, in writings of which I am uninformed, it will be of interest to examine the following statement of it in the work referred to:

"The working out of the process is here somewhat difficult to follow; but it appears to me that as fast as the number of bodily and mental faculties increases, and as fast as the maintenance of life comes to depend less on the amount of any one, and more on the combined action of all; so fast does the production of specialties of character by natural selection alone, become difficult. Particularly does this seem to be so with a species so multitudinous in its powers as mankind; and above all does it seem to be so with such of the human powers as have but minor shares in aiding the struggle for life—the esthetic faculties, for example.

"It by no means follows, however, that in cases of this kind, and cases of the preceding kind natural selection plays no part. Wherever it is not the chief agent in working organic changes, it is still, very generally, a secondary agent. The survival of the fittest must nearly always further the production of modifications which produce fitness; whether they be modifications that have arisen incidentally, or modifications that have been caused by direct adaptation. Evidently those individuals whose constitutions or circumstances have facilitated the production in them of any structural change consequent on any functional change demanded by some new external condition, will be the individuals most likely to live and to leave descendants. There must be a natural selection of functionally-acquired peculiarities, as well as of incidental peculiarities; and hence such structural changes in a species as result from changes of habit necessitated by changed circumstances, natural selection will render more rapid than they would otherwise be." (Prin. of Biology, Vol. 1, p. 454.)

ROBERT M. PIERCE.

PHILADELPHIA, PA.

EUPROCTIS CHRYSORRHŒA IN MASSACHUSETTS.

ON May 13th Dr. Roland Thaxter brought me a few larvæ he had found on pear trees in Cambridge. After examination I identified these as *Euproctis* (*Porthesia*) *chrysorrhœa* Linné, commonly called the Goldtail, a species hitherto unrecorded from this country. It occurs locally in England, is abundant in central and southern Europe, and is also recorded from northern Africa and Asia Minor. When found in great profusion their ravages are exceedingly serious.

May 15th, Dr. Thaxter and I visited a locality in Somerville, not far from the Cambridge line, and found the larvæ extremely abundant on pear, and somewhat less so on apple. We were told that they were noticed last spring for the first time and that they fed only on pear and apple. The larvæ feed gregariously and build small, tent-like nests. A slight jar causes them to drop from the trees and they give rise to further annoyance by the urticating power of their hairs. The larva may be described briefly as blackish with ochreous hairs, dorsal line double with pale ochreous, reddish markings, subdorsal line broad, with interrupted white markings; the tenth and eleventh segments have a conspicuous, dorsal, red tubercule. The head and thorax of the moth are white; the abdomen is white, with a brown or buff anal tuft; the wings are pure white, frequently with a black spot on the lower posterior margin of the fore wings. The alar expanse is 32–38 mm.

As previously stated, they have been found to feed here only on pear and apple, and the attempts I have made to effect a change of food have, thus far, failed. Abroad, however, the species has many food plants, apple, pear, plum, hawthorn, bramble, elm, willow, beech, oak, hazel nut, and hornbean being among those recorded. At present the larvæ seem to be confined to a rather limited area in Somerville and Cambridge. It is difficult to give an adequate idea of their abundance, their increase since last year, and their destructiveness. If the

species should become well established it will prove especially harmful; vigorous measures should, therefore, be taken to prevent its spreading.

SAMUEL HENSHAW.

CAMBRIDGE, May 17, 1897.

SCIENTIFIC LITERATURE.

Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Herausgegeben von der Deutschen Zoologischen Gesellschaft. Generalredakteur: FRANZ EILHARD SCHULZE. Berlin, R. Friedländer und Sohn. 1897.

IT is about a hundred years since the last editions of Linnæi Systema Naturæ appeared, pretending to give a systematic descriptive enumeration of all natural history objects known at that time. Those were days when one man could undertake such a work including all the known animals, plants and minerals. In most cases these editions were baseless and uncritical compilations, but, nevertheless, their influence was so stimulating that before the end of the eighteenth century the task of keeping these descriptive lists up became impossible. The three kingdoms separated first, but even the animal kingdom alone got beyond the control of the zoologists, and no descriptive list of all the animals was undertaken till our days, as Cuvier's Regne Animal did not pretend to take cognizance of any but the more common or remarkable forms.

The only publications of recent years, however, which, if kept up, would finally present in one series descriptions of all known animals are the catalogues of the specimens in the British Museum, but on the scale upon which these volumes are planned it will take ages before the task can be completed.

Recognizing this, the German Zoological Society has boldly stepped to the front and not only planned, but actually begun, a publication which intends to embrace systematic diagnoses of all living animals under the title 'Das Tierreich.' The plan of this gigantic undertaking is as follows:

The various groups of animals are to be worked up by specialists, a list of sixty-four colaborators having already been published. Their work is to be supervised by a number of division editors, twenty-one of whom are named. At the head of the whole, as editor-in-chief, is Dr. F. E. Schulze, of Berlin, assisted by an editorial committee consisting of the President of the German Zoological Society and Dr. K. Möbius, in Berlin.

In order to obtain uniformity, certain rules have been adopted: thus the nomenclature is to follow the canons of the German Zoological Society; the color designations are to be according to Saccardo's Chromotaxia, the abbreviations are to be uniform, etc.; subspecies are to be recognized; a short diagnosis of each form is to be given, accompanied by a list of all synonyms since 1758, as well as references to the most important literature and a brief statement of the geographical distribution; systematic synopsis of groups and keys to facilitate identifications are to be a special feature, and diagrams and figures in the text will illustrate the more difficult points. Every group is to be published as soon as finished, irrespective of its position in the system and as a separate whole, with title and index. Upon the completion of each division, table of contents and index follow, as well as a general table and index when the whole work is finished. The various parts are to be sold separately. The work will be published in the German language; exceptionally, however, also in English, French or Latin.

It will be seen from the above that the German Zoological Society has in view a most ambitious and colossal undertaking, which, if it is ever brought to conclusion, must prove of inestimable value to zoological science. The plan seems well considered and the names of the contributors thus far secured promise well for the thoroughness of the work to be undertaken. But will it ever be finished? Or rather, will it be finished within such a period that the beginning will not be completely antiquated before the editor-in-chief writes *finis* on the last page of the last part? We all remember the fate of another German undertaking of vastly less ambitious dimension, viz.: Brown's 'Thierklassen,' which, although begun in 1859, is not yet completed, and anxiously ask whether it may not require more than

one generation to finish the 'Tierreich.' The prospectus does not even contain an estimate as to the aggregate number of volumes or signatures the whole may embrace, and the present reviewer has no means of furnishing such an estimate except for a limited branch. The first part, relating to birds, having been issued, it is possible to calculate the size of the portion relating to the class *Aves*, and to assert that, if the same plan is followed throughout, the birds alone will fill 10 large octavo volumes of about 600 pages each. The question then is, How many volumes are the other classes to occupy, and how many the insects alone?

The price cannot be considered high, in view of the character of the work. Regular subscribers who bind themselves to take all the parts published during the first five years will have to pay an average price of Mark 0.70 per signature, or about 18 cents, while the various parts will be sold separately at a rate about one third higher. On the above calculation the birds when concluded would cost about 65 dollars to subscribers and 87 dollars to others.

As stated above, the first part is now published and is before us.* It treats of the goatsuckers and swifts and is the work of Mr. Ernst Hartert, the director of the museum in Tring. If the rest of the work is going to keep up with the standard set by this beginning there can be no doubt that the undertaking will be a scientific success. But then, Mr. Hartert is not only exceptionally fitted for this work, but he has also had exceptional opportunities. Brought up with German thoroughness, he was transplanted to England, where, unfettered by national prejudices, he was free to select and develop the best sides of English methods. Five years ago he monographed these very families of birds for the catalogue of the British Museum, with the unrivaled material of that institution before him. He has thus had an opportunity to study specimens of nearly all the species he treats of, and his work thus partakes but little of the character of a compilation. The first part of the *Tierreich* is a condensed review, in German, of that monograph brought down to date. On the whole, the changes are few, showing how well the work was done from the start. 21 species and subspecies are recognized as having been added since 1892, while it has only been necessary to add or reinstate five species and subspecies described previous to 1892. On the other hand, only two or three species then recognized as such have now been reduced to subspecies. Two additional genera are recognized, viz.: *Cosmetornis*, reinstated, and *Nannochordeiles*, established in 1896. The changes in nomenclature are not many. The author has accounted for most of the changes in a separate paper published in the *Ibis* for 1896, to which those wishing further detailed information are referred. One important change in nomenclature, however, has not been noted there, as it was brought about by Dr. Reichenow only a short time ago. The latter found that Pallas has not established the genus *Apus* for *Monoculus apus*, Lin., as previously supposed, but that Scopoli, who proposed *Apus* for the Swift in 1777, had on a previous page established the genus *Apos* for the *Monoculus*. Of course, the latter is only a lapsus in transliterating απους and is, in every sense of the word, a synonym of *Apus*, which must, therefore, be considered preoccupied. Reichenow considers the case parallel to that of *Picus* and *Pica*, names allowable under the codes of nomenclature, but there is absolutely no similarity between the cases. The latter generic appellations are distinct and separate Latin classical names for widely different birds, though the philological root of the two words is probably the same. But in *Apos* and *Apus* it is the same word, by some lapsus, or another, mutilated in the case of *Apos*. Were we to accept Reichenow's ruling we should have one species *Apos apus*, the monoculus, and another *Apus apus*, the bird, which would nearly nullify the idea of zoological nomenclature, viz.: to have a different name for each different species.

* Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Herausgegeben von der Deutschen Zoologischen Gesellschaft. Generalredakteur: Franz Eilhard Schulze.—1. Lieferung. Aves. Redakteur: A. Reichenow.—Podargidæ, Caprimulgidæ und Macropterygidæ bearbeitet von Ernst Hartert, Direktor des Zoologischen Museums in Tring (England). Mit 16 Abbildungen im Texte.—Berlin. Verlag von R. Friedländer und Sohn. 1897. 8vo. viii + 98 pp.

While we must thus congratulate the German Zoological Society upon the eminently satisfactory beginning of its enormous enterprise, and the zoological world at large upon the prospect of the assistance and stimulus which such a work must necessarily afford, we cannot forbear expressing the reservation that the promotors of the task when expecting that 'Das Tierreich' may become the foundation and starting point of all future systematic research ('Grundlage und Ausgangspunkt aller künftigen Systematik'). A work to become, in our days, the foundation and starting point of future systematic research must break new ground, open up new views and utilize new material to a much greater extent than it is possible in a general work of the scope of 'Das Tierreich,' with its necessarily excessive condensation and also necessarily uneven authority. No matter how prominent the monographers may be, it is conceivable that the work of many may fail to receive the universal acceptance which is essential to the fulfilment of the Society's fond hope. The time is not ripe yet for a new starting point. We are still in the midst of a period of development and upheaval. The natural relationships of animals are, to a great extent, obscure as yet, and the systematic arrangement in the work is bound to be greatly artificial in many groups at least. It is even to be feared that the very conciseness of the form and the consequent unavoidable preciseness of the statements, coupled with the superficial uniformity of the arrangement, may tempt the habitual generalizers, who are deficient in the special knowledge which 'Das Tierreich' is destined to be an expression for, into a belief that zoological science has reached a well-balanced uniformity which might make it safe to use the work as an undisputed authority in all branches upon which to build daring and glittering generalizations. For the working specialist, it is safe to say, no general work, however, well executed, will even supersede the Systema Naturæ of Linnæus as a starting point.

LEONHARD STEJNEGER.

A Study in Insect Parasitism: A Consideration of the Parasites of the White-marked Tussock Moth, with an account of their habits and interrelations, and with descriptions of new species. By L. O. HOWARD. U. S. Department of Agriculture, Division of Entomology, Technical Series (Bulletin) No. 5. [April] 1897.

One of the first insects which met the writer's eye on landing in New York in 1887 was the larva of the white-marked tussock moth (*Orgyia Hemerocampa leucostigma*). It is a beautiful creature, but destructive to the shade trees. It exhibits 'warning colors,' and is not eaten by the sparrows; so there is no telling how abundant it might become but for parasites and diseases.

Dr. L. O. Howard undertook a few years ago to study the life history and parasites of this insect, especially as observed in the City of Washington. One might have supposed that at this late date there was nothing new to be learned about so common a creature, but Dr. Howard knew better, and the present bulletin exhibits part of the new facts ascertained. It is not necessary to recount these facts, as the bulletin itself can be obtained without difficulty, but I should like to emphasize two or three points.

In the first place, we see that most admirable work may yet be done even in the very midst of our great cities, and that even new species may be obtained in tolerable abundance. Dr. Howard, in the present bulletin, records thirty-five parasites and hyperparasites of the *Orgyia*, of which no less than nine are described as new, all the new ones being from the District of Columbia. So even our business men, who have but a spare half-hour or twenty minutes at noon, can, if they are so inclined, gather a lot of *Orgyia* cocoons and breed parasites, with a fair chance of turning up actual novelties! Here, indeed, is an exciting and interesting pastime for young clerks and such persons whose city life is at present rather dull.

Secondly, we observe that when the various factors bearing upon the life of an insect are considered together, the interest of the subject is enormously increased. It is unfortunate that at least nine-tenths of the current literature of entomology relates either to dead specimens removed from their natural environment, or when referring to living insects takes an extremely narrow view of the subject. It results from this that one of the most fascinating

studies known, and one which yields abundant facts of philosophical interest, has the reputation in many quarters of being excessively dry and unprofitable. It may be laid down as a law that no one can take a really intelligent view of a group of insects while ignoring all those outside factors which influence its being and have made it what it is. Such a one may become skillful in determining species, but he is like a collector of coins, who should know perfectly every kind of coin which he possessed, but neither knows nor cares when or by whom the coins were made nor what the figures and inscriptions upon them meant.

Thirdly, it is perfectly clear that entomological works of the best kind can no longer be written by one man unaided. Dr. Howard could by no means have given us so satisfactory a treatise had he not been helped by his several assistants and investigators. Such help is gladly rendered by entomologists to one another, when it is known that it will be judiciously used and justly credited. It is a pleasure to assist such a man as Dr. Howard, and it is to be hoped that all who can cooperate usefully with him will make haste to do so. For while many of us cannot by ourselves write profitably on various subjects, we may together afford the materials, which, put together and added to by a competent person, will result in the production of an admirable treatise. Those who, like Dr. Howard, have shown that they can be trusted to use properly the materials or information supplied to them should receive strong support; while others (there are such) who persistently ignore field notes and biological data, or do not quote those data correctly, out of sheer carelessness, should not be supplied with material.

When the writer began to describe western hymenoptera he was solemnly warned that, not having access to the type specimens, he would be very likely to make synonyms. So far, he believes there are not more synonyms among his names than among an equal number of those proposed by Eastern entomologists—those detected on sending the types east are very few, but even if there were, he believes he would be justified, because he gives the exact conditions under which the insects were taken, while most of those described in the East are credited vaguely to 'Colo.', 'N. Mex.', etc., to the extreme vexation of one working on the fauna of this region. It is true, of course, that the material so described has been mostly sent in with inadequate labels, but the writer knows cases enough where the available data were not quoted; and certainly had any serious effort been made to get professional collectors to cite localities, etc., the information would have been forthcoming. This is shown by the fact that Mr. W. H. Edwards almost always manages to get excellent details. Compare Mr. Edwards' accounts of the butterflies taken by Bruce with the records of moths collected by the same entomologist but published by others. Compare also the different reports on the St. Vincent material collected by Mr. H. H. Smith.*

Several other matters might be touched upon. How interesting it is to read of the indirect influence of the sparrows on the *Orgyia*, of the fluctuation of the several insects from year to year, of the way in which the parasites abounded in different degrees in different parts of the city, and a dozen other things. The inadequacy of a bald record that one insect infests another is clearly brought out. Thus, while it is correct to say that *Apanteles hyphantriæ* and *Chalcis ovata* both infest the *Orgyia* and *Hyphantria*, they infest them in utterly different proportions.

There is little or nothing to criticise adversely. *Theronia fulvescens*, credited to Brullé, was, I believe, described by Cresson. On p. 52 it is said that the dipterous parasites apparently had no hyperparasites. But *Hemiteles townsendi* was surely such, as is duly indicated on p. 31.

The promptness of publication is very much to be commended. The Bulletin was trans-

* In the report on the Diptera, Tr. Ent. Soc. Lond., 1896, Professor Aldrich, reporting on the Dolichopodidæ and Phoridæ, gives the altitude, etc., while Professor Williston, reporting on the other families, generally fails to give any such data. It cannot be supposed that Mr. Smith carefully labelled two families of flies, and was quite careless about the rest! One of the individuals who worked up a group of the St. Vincent fauna (not flies) confessed to me that he threw away Smith's minute-locality labels.

mitted for publication on February 1st, and it comes to hand early in April. This is in great contrast with the delay which formerly used to occur.

T. D. A. Cockerell.

Mesilla, N. M.

Marine Fossils from the Coal Measures of Arkansas. By James Perrin Smith. (Preface by John C. Branner, late State Geologist of Arkansas.) Pp. 72. Plates xvi.–xxiv.

This memoir, reprinted January 7, 1897, from the Proceedings of the *American Philosophical Society*, Vol. XXXV., No. 152, is also "the ninth of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University." It was prepared at the request of Dr. Branner and deals with the rarer, and therefore more interesting, fossils of the Coal Measures. In these strata marine species furnish the most valuable data for the purposes of correlation. Heretofore they had been announced from but one locality: now, after a careful study of the material brought together by the last (Branner) survey, Professor Smith is able to announce them from twenty-one additional localities, extending from Independence county, on the east, to the Indian Territory, on the west. Forty-eight genera are represented by ninety species, of which forty-eight are found in the in the Lower Coal Measures and fifty-two in the Upper, ten species being common to both. The author characterizes the fauna as poor, such as would wander in whenever, by subsidence, the shallow waters became more habitable, and he also points out that, under the conditions then prevailing, it could not become well established, as it was frequently forced to migrate. In consequence of this, a gradual transition from the fauna of the Lower Carboniferous Limestone does not exist in this region. No attempt is made to classify the beds more minutely than into Upper and Lower Coal Measures, and even this is at times uncertain, especially when their marked similarity, folding and faulting are taken into consideration. Then follows a list of localities in which marine fossils were found, seventeen in the Lower Coal Measures and four in the Upper (one of which, Poteau mountain, is two miles west of the Scott county, Arkansas, line, in Indian Territory), together with the names of the fossils, character of the deposits, and the names of the collectors. A comparison is made with the Permo-Carboniferous of Kansas and Nebraska and the strong faunal resemblance of the Upper Coal Measures of Arkansas to the youngest Paleozoic rocks of Nebraska shown. The relations of the Arkansas deposits to those of Texas are also noted: "None of the characteristic ammonite genera [of the Permian] were found in the Arkansas region, but nearly every fossil found in these Coal Measures was also found in Texas. And in the Texas Permian nearly all the species excepting the ammonites were found in the underlying Upper Coal Measures. This makes the analogy between the Upper Coal Measures of the two regions very strong."

In view of this Professor Smith concludes "that while some of the beds in western Arkansas are very high up in the Coal Measures, none that belong above them are as yet certainly known, and the Poteau mountain syncline, across the line in Indian Territory, is the only place where there is any likelihood of finding Permian deposits." Some very interesting comparisons are also made with foreign faunas: for instance, of the Lo-ping fauna in China "nearly all of the species are either found in America, or they have their nearest relatives there." In this connection another point of unusual interest is brought out, viz., that many of the species which are "very common in America and Asia are unknown or rare in Europe, which fact would tend to prove a connection with Asia by water, and the separation of the European and the American Upper Coal Measure deposits by a land barrier." In short, our author regards the two regions, America and Asia, as belonging to the "same zoological province, the Pacific Carboniferous sea." Moreover, "many of the American species that are found at Lo-ping are also found in the Salt Range beds," thus extending the close relationship to India. Of the Upper Carboniferous fauna, at Itaitúba, Brazil, described by Derby, twelve out of twenty-seven species of brachiopods are shown to be "iden-

tical with American forms, although most of these are cosmopolitan." The *Strophalosia* of this locality by its close relation to Australian forms would indicate "a closer connection with the Australian, or Southern, Carboniferous region than with the Pacific Province."

But the classification and age of the Arkansas Coal Measures is the most difficult problem the author has to deal with and the most unsatisfactory, being at best provisional. He says: "The Coal Measures of Arkansas have been temporarily classified by the Survey, for the sake of convenience, as Upper, or Productive, and Lower, or Barren Coal Measures. The division is not based on any paleontologic or stratigraphic break, but merely on the occurrence or non-occurrence of coal.

"The divisions that are recognized in Pennsylvania could not be recognized in Arkansas, but the strata of the two sections are correlated, as far as possible, with the scanty data now at hand.

"Of the age of the Lower Coal Measures we have only stratigraphic evidence, their position above the limestone of the Lower Carboniferous and below the coal-bearing beds of the Upper Coal Measure being unmistakable. But their known fauna and flora have been too limited and indecisive to enable us to correlate the stages with those of other Carboniferous areas, since collections have been made in but few places, and these chiefly in sandstones, where the preservation of fossils is usually unsatisfactory and the determination uncertain.

"But the Lower Coal Measures correspond in a general way to the Strawn and the lower part of the canyon division of Texas, to the Pottsville Conglomerate series, the Lower Productive Coal Measures, and part of the Lower Barren Coal Measures of Pennsylvania. The series corresponds, in the main, to the Middle Carboniferous limestone of eastern Russia."

Concerning the Upper Coal Measures of Arkansas, Professor Smith expresses the opinion that they "correspond to the upper part of the Canyon and the whole of the Cisco division of Texas." He infers, from the presence of certain fossils, that the beds of Poteau Mountain, I. T., are probably of the age of those in the Lo-ping district, and that the yellow shales of Scott county, Arkansas, are probably of the age of the Carboniferous Limestone at Moscow and the west slope of the Urals.

Under the heading, 'Paleobotanic Evidence,' reference is made to an unpublished report by Messrs. H. L. Fairchild and David White on the *Fossil Flora of the Coal Measures of Arkansas*, which "throws much new light on the stratigraphic and regional distribution of species, and has been of material aid in correlating the Arkansas strata with those of other regions." It may not be out of place here to express the hope that this monograph may soon be printed "They prove that all the Coal Measure plants* published from Arkansas belong to the horizon of the Upper or Productive Coal Measures." The position of the Van Buren plant bed is found to be below the marine beds of Poteau Mountain and above those occurring in the vicinity of Fort Smith, the last named horizon being above that from which most of the coal is obtained. While not entirely devoid of plant remains, the rocks of the Lower Coal Measures furnish but little evidence of a paleobotanical kind suitable for correlation purposes.

The Pacific Carboniferous sea is next discussed, including the following topics: Revolution in Devonian Time; The Carboniferous Sea; Upper Carboniferous in the West; The Pawhuski Limestone; The Interchange of Life between East and West (the most striking topic); Replacement of Limestone by Coal-bearing Formations in Western Europe; and Land Areas in the West. The Permian Pacific Ocean and the Triassic Pacific Ocean are also touched upon.

As to the time of the Ouachita Uplift Professor Smith writes: "The youngest rocks known to take part in the Ouachita Mountain system belong to the Upper Coal Measures, and the disturbance must have taken place at the border between the Carboniferous and the Permian. Still it is not unlikely that deposits of Permo-Carboniferous age may yet be found at some places in that region. * * *

"This uplift may be of the same age as that movement in the Appalachians which cut off the Upper Barren Coal Measures of Pennsyl-

*Exclusive of those described from Washington county.

vania and West Virginia entirely from the western sea; in these deposits no marine fossils are found, but only land plants and fresh-water Crustaceans and a few fresh-water mollusks."

A table showing the correlation of the Coal Measures of Arkansas and similar deposits in Indian Territory, Texas, the Mississippi Valley, Pennsylvania, China and other parts of Asia, Russia and the Ural Mountains, India and South America, closes what may be termed the first part of this contribution. The remainder, pages 25–72, consists of an annotated list of the Marine Fossils of the Arkansas Coal Measures, together with a check list showing their stratigraphic distribution and the localities of their occurrence in Arkansas and elsewhere. Nine excellent plates accompany the text. A new species of *Gastrioceras*, *G. branneri*, and a variety of *Pronorites cyclobolus*, Phillips, called *arkansiensis*, are described. A description of the trilobite *Phillipsia* (*griffithides*) *ornatea*, by Capt. A. W. Vogdes, U. S. A., quoted from the Proceedings of the California Academy of Science,* is also inserted.

By those interested in the organic side of geology Professor Smith's paper will be read with much satisfaction. The comparative study of faunas, their relations and distribution, is a line of investigation which promises much in the near future.

Frederic W. Simonds.
University of Texas.

Clay Deposits of Missouri. By H. A. Wheeler. Missouri Geological Survey, Vol. XI., 622 pp., 39 pl. Jefferson City, 1896.

The recent report upon the Missouri clays, while essentially economic in character, discusses a number of problems of wide scientific interest. Among these the nature of plasticity as exemplified in clays is perhaps the most important. Professor Wheeler finds, as a result of physical tests and the microscopic examinations of Haworth, that the fine plate theory of Johnson and Blake† is the only one which satisfactorily explains the facts, and that fineness in itself has no real bearing on the plasticity.

It is found that the fusibility of a clay is a function not only of the chemical composition, but of the fineness of grain and the density. The following formula is developed and thought to be satisfactory for approximate results, but it is held that absolute results can only be obtained by testing.

$$FF = \frac{N}{D + D' + C}$$

In this FF represents the numerical value of refractoriness. N represents the sum of the non-detrimental constituents, or the total silica, alumina, titanic acid, water, moisture and carbonic acid. D represents the sum of the fluxing impurities or the alkalies, oxide of iron, lime and magnesia. D' represents the sum of the alkalies, which are estimated to have double the fluxing value of the other detrimentals, and hence are added twice. C has the following values:

$C=1$,	clay	coarse grained	sp. gr.	over	2.00
$C=2$,	"	"	"	"	2.00 — 2.25
$C=3$,	"	"	"	"	1.75 — 2.00
$C=2$,	"	fine	"	"	over 2.25
$C=3$,	"	"	"	"	2.00 — 2.25
$C=4$,	"	"	"	"	1.75 — 2.25

There are a large number of physical tests, chemical analyses and detailed descriptions of processes, and the work is one of wide interest and considerable value.

H. Foster Bain.

Am. Jour. Sci. (2), XLIII., p. 357. 1867.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, MAY.

On Urethanes: By O. Folin. When sodium methylate is treated with acetbromamide the yield is not, as might be expected, a hydroxylamine derivative, but a urethane which is formed by a molecular rearrangement during the course of the reaction. The purpose of the author was to test this reaction, to find out if it was general and also the effect of different negative and positive groups substituted in the bromamide. As a result of a number of experiments with different radicals, it was found that the difference in the nature of the radical did not affect the reaction, which is a general one that can be used in the preparation of urethanes. The urethanes when treated with phosphorus penta-

* Second Series, Vol. IV., p. 589 *et seq.*

chloride yield chlorformanilides, thus offering a simple and easy method for preparing these substances. When free urethane is treated with phosphorus pentachloride a more complex reaction takes place, a carbamide chloride being formed. When urethane and phosgene are brought together, three different reactions take place, depending to some extent upon the relative amounts of the substances present.

Action of Phosphorus Pentachloride on Aniline and its Salts: By J. ELLIOTT GILPIN. The author has obtained several products by the substitution of one or more chlorine atoms of the phosphorus pentachloride by residues of aniline. When aniline hydrochloride and phosphorus pentachloride are heated together a volatile compound having the composition $PCl_2(NC_6H_5)$ is formed. This is unstable and readily decomposed by water. A product, obtained by treating the aniline with phosphorus pentachloride, $PCl(NHC_6H_5)_4$ is, on the other hand, extremely stable, resisting, in general, all except the most energetic reagents. Derivatives of this substance cannot be obtained readily, if at all, as it is completely decomposed if any action takes place. When heated it forms a black substance, containing probably carbon and phosphorus, which is remarkable for its stability. Compounds analogous to the one formed from aniline can be obtained from the toluidenes.

On the Preparation of Metabrombenzoic Acid and of Metabromnitrobenzene: By H. L. WHEELER and B. W. MCFARLAND. The most general method that has been used for the preparation of these compounds consisted in heating the benzene compound with bromine or ferrous bromide in a sealed tube for several days. The authors find that the reactions can be performed in an open vessel and in a short time by using iron as a bromine carrier. This is even better than already prepared ferrous bromide. The substance is warmed with iron wire, and bromine is added slowly until the action is complete. The method was tested in a number of cases and proved to be one of general applicability.

On the Non-existence of Four Methenylphenylparatolylamidenes: By H. L. WHEELER. In an article published recently Walther describes the preparation of this substance by four different methods. Each method, according to him, gives a new amidine, and he supposes them to be isomers. The author of this paper has repeated the work, as the results obtained by Walther are not in harmony with the generally accepted behavior of amidines, and finds that the products obtained by the first and second methods are mixtures, while the third and fourth methods yield one and the same product, thus showing that instead of four only one amidine was obtained.

South American Petroleum: By C. F. MABERY and A. S. KITTELBERGER. In the present paper Professor Mabery contributes further results obtained in his investigations on petroleum. This oil was obtained in South America and differs in some ways very much from the product obtained in this country. The methods hitherto used for isolating the products failed in some cases, and the exact nature of the products could not be determined. The investigation showed, however, that the hydrocarbons present consisted of a series containing less hydrogen than $C_n H_{2n+2}$ and more than $C_n H_{2n-6}$ with perhaps a trace of these.

The Action of Certain Alcohols on Asymmetadiazoxylenesulphonic Acid: By W. B. SHOBER and H. E. KIEFER. The action of this diazo compound with methyl, ethyl and propyl alcohols was studied, and in each case two amides, one the xylenesulphon amide, and the other the amide of the xylenesulphonic acid of the alcohol, were obtained, whether the reaction was carried on at ordinary temperatures or under pressure. The methoxyxylenesulphonic acid and its salts were made and studied, as were also those of the propyl acid. By the oxidation of Asymmetamethoxyxylenesulphonamide they obtained methoxysulphaminetolnic acid and from it prepared its salts.

The Action of Ethylic Oxalata on Camphor: By J. B. TINGLE. Several structural formulæ have been assigned to camphor, and in all of these the presence of the group CH_2 CO is recognized. In the study of the related bodies, the diketones and keto-acids, the compounds chiefly investigated have contained strongly negative groups; but in the present investigation the author has used substances only feeble in this respect, in hopes of throwing some light on this class of

bodies. The results obtained, however, do not warrant any strong assumptions either way. He prepared ethylic camphoroxalate and the free acid, and from a study of their behavior as compared with the compounds studied by others he drew some conclusions as to their probable structure.

Preparation of Zinc Ethyl: By A. Lachman. The author has improved the method for the preparation of zinc alkyls, in which the copper-zinc couple is used. The difficulties met with in working according to the former directions are avoided by mixing zinc dust and copper oxide and heating in a glass tube in a current of hydrogen. In this way an excellent alloy is obtained. Some suggestions are given as to the preservation and use of the zinc alkyl.

A Simple Test for the Halogens in Organic Halides: By J. H. Kastle and W. A. Beatty. The authors have devised a simple method of testing for the presence of the halogens in organic compounds. The substance, if not volatile, is heated with a mixture of silver and copper nitrates. The product is treated with dilute sulphuric acid and zinc, to reduce any halogen compound of silver, then filtered and tested with silver nitrate. If the substance is volatile it is heated in an S-shaped tube, the nitrates being placed in the bend beyond the substance and the two heated alternately, so that the volatile substance is distilled into the nitrates. The method was found applicable to all classes of compounds.

The following books are reviewed in this number of the *Journal*: Commercial Organic Analysis, A. H. Allen, Vol. III., Pt. III.; Engineering Chemistry, T. B. Stillman; Ptomaïns, Leucomaïns, Toxins and Antitoxins, V. C. Vaughan; A Laboratory Manual of Inorganic Chemistry, R. P. Williams; Laboratory Calculations and Specific Gravity Tables, J. S. Adriance.

J. Elliott Gilpin.

THE AMERICAN GEOLOGIST, MAY.

'Changes of Level in the Bermuda Islands,' by Ralph S. Tarr. The conclusions of previous observers are reviewed and some new facts presented. The results, as based upon all the investigations yet made, show that the Bermudas are underlain by a base rock of shell and coral fragments formed by wave action. This shell sand beach was then consolidated into a dense limestone and suffered some aërial erosion, and was finally depressed and attacked by the waves. In the last stage it was partly covered by beach deposits of pebbles and shells. Then came an uplift of 40 or 50 feet during which land shells lived on the beach deposits. Accumulations of blown sand were made and the outline of the Bermuda hills perfected by the action of the winds. Since then there has been a depression causing much land to disappear and the outline of the area to become very irregular.

James P. Kimball completes his examination of the 'Physiographic Geology of the Puget Sound Basin.' It describes the following chief historic events. The deposition of the Tejon strata of the Eocene, their subsequent disturbance, followed by denudation, reaching base-level during the glacial period. Glacial drift was accumulated in the axial part of the basin. Later alternations of level brought about fluvial erosion of the drift mantle, then submergence below sea level flooded the lower valleys, producing the present type of inlets and sounds. In recent times partial emergence has taken place.

E. W. Claypole describes a large Dinichthys, considered as belonging to a new species.

'On the Genesis of Clay Stones,' by H. W. Nichols. Claystones are regarded as crystalline aggregates whose growth has been modified by the large amount of foreign matter (clay) present, and the conditions of their formation are the same as those which would, in more favorable positions, lead to the formation of an aggregate of calcite crystals of the more usual form. There are two conditions which appear favorable to the formation of concretions: (1) the presence of arragonite with the disseminated calcite of the clay beds, and (2) the presence of unstable humus acids. The more soluble arragonite continuously goes into solution, thereby over-saturating it with respect to calcite, upon the particles of which the calcium carbonate of the solution is deposited. Thus the calcite grows as the arragonite diminishes.

'Nomenclature of the Galena and Maquoketa

Series,' by F. W. Sardeson. A supplementary discussion to the papers by the same author on these formations, showing the confusion arising from a shifting nomenclature.

N. H. Winchell gives a partial bibliography with notes on 'The Age of the Great Lakes of North America.' It is interesting to have the various opinions thus summarized for reference. The prevailing belief has been that these lakes occupy preglacial valleys which have been shut off by earth movements and by glacial accumulations.

Warren Upham discusses the 'Relation of the Lafayette or Ozarkian Uplift of North America to Glaciation.' Both are referred to the Quaternary.

SOCIETIES AND ACADEMIES.

THE 95TH REGULAR MEETING OF THE CHEMICAL SOCIETY OF WASHINGTON, APRIL 8, 1897.

The first paper, 'Three Early American Chemical Societies,' was read by Dr. H. Carrington Bolton.

The first Chemical Society ever organized in either hemisphere was founded at Philadelphia in 1772, forty-nine years before the Chemical Society of London, the oldest in Europe. The President was Dr. James Woodhouse, professor of chemistry in the medical department of the University of Pennsylvania, and the first Vice-President was Felix Pascalis Ouvrière, a naturalist born in France and sometime a resident of Santo Domingo. On December 10, 1801, Robert Hare presented to the Chemical Society of Philadelphia his memorable paper on the 'Hydrostatic Blow-pipe,' which was published by the Society in the following year as a pamphlet with the title: 'Memoir on the Supply and Application of the Blow-pipe.'

In 1811 a second Chemical Society was founded in Philadelphia called the 'Columbian,' under the presidency of Professor James Cutbush. The constitution of this Society provided for levying fines on absent members and those who refused to accept office when elected. The Society numbered sixty-nine members, of which thirty-one were foreign chemists, and thirteen junior members; these included the most prominent chemists and philosophers living on both sides of the Atlantic. In 1815 The Columbian Chemical Society of Philadelphia published one volume of memoirs; this contained twenty-six essays on a variety of topics original, speculative and practical.

The third Chemical Society was the Delaware Chemical and Geological Society, organized at Delhi, New York, in 1821; it was, however, short lived and issued no publications.

Dr. Bolton's essay contained brief biographical sketches of the prominent members of these early Societies.

The second paper, on 'The Experimental Determination of the Hydrothermal Value of a Bomb Calorimeter,' was read by H. W. Wiley and W. D. Bigelow. The methods previously suggested by other authors for this purpose were reviewed and their advantages and disadvantages discussed. The authors employed a relatively large body of warm water, instead of a very small portion, as had previously been used. Two Beckmann thermometers were employed, which made it possible to read a temperature to a thousandth of a degree, so that the error which would otherwise arise from the slight change of temperature was overcome by the accuracy in reading.

The last paper, on 'The Influence of Vegetable Mold on the Nitrogenous Content of Oats,' was read by Dr. Wiley. Attention having been called several years ago to the large increase in the nitrogen in sugar cane grown in the muck soils of Florida, an investigation was instituted by the Department of Agriculture, in 1894, to determine in what way the humus of such soils influenced the nitrogen contents of cereal crops. The first year's investigation was preliminary, but it showed distinctly that oats grown on soils rich in vegetable mold contained a larger percentage of nitrogen than that grown in other soils. The total increase is, in general, about 25%. This was not in the grain alone, but also in the straw. The second year's investigation verified this result. The increase was largely in amid nitrogen, the percentage of proteids not being greatly increased. The results are, therefore, not so interesting from an economic point of view. When it is remembered that these vegetable soils are extremely rich in nitrogen,

and when it is further considered that they are quite deficient in nitrifying organisms, it is fair to conclude that at least a portion of this excess of nitrogen which they contain is assimilated directly from the vegetable mold without previous oxidation to nitric acid. Data was adduced which showed that the addition of phosphatic fertilizers tended to diminish the actual percentage of nitrogen in the crop harvested.

At the end of the regular program Professor Warder exhibited some photographs which showed the power of various chemical substances to absorb X-rays, and explained the technique of the manipulation.

V. K. Chesnut,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, MAY 13, 1897.

The President announced the death, on May 3d, of Martin L. Linell, an active member of the Society.

Mr. B. E. Fernow referred to the recent increase of pin holes in timber from the Southern States, caused either by some Ptinid beetle or a Scolytid, and discussed the possibility of preventing damage by some system of timber management.

Dr. E. F. Smith showed Beijerinck's recently published paper on the 'Cecidiogenesis and alternation of genera of *Cynips calicis*,' and briefly reviewed the work.

Mr. Schwarz exhibited specimens of the Meloid beetle, *Phodaga alticeps* Lec., and read a letter from Mr. Hubbard detailing the habits of this insect.

Mr. Schwarz presented a paper entitled 'Two genera of beetles new to the United States.' The genera are *Cylidrella*, family Trogositidæ, discovered by Mr. H. G. Hubbard at Yuma, Arizona, preying upon a Scolytid in Parkinsonia wood, this genus having been founded by Dr. Sharp upon a single species, *C. mollis*, found by Mr. Champion in Guatemala; and *Latheticus*, family Tenebrionidæ, found by Mr. Hubbard under Mesquite bark at Indio, in the Colorado desert of California, the only other species of this genus, *L. oryzæ* Waterhouse, having been found in rice brought to England from India.

Mr. Banks presented a paper entitled 'Three new lace-winged flies,' in which the following species were described: *Chrysopa sabulosa*, *C. Fraterna* and *Leucochrysa americana*.

Mr. Howard presented a communication on 'An interesting wax insect from California.'

Mr. Ashmead presented a paper entitled 'The genera of the Encyrtinæ,' which reviewed the history of the subfamily and included a table of the known genera, to which he had added nine.

L. O. H.

ANTHROPOLOGICAL SOCIETY.

The 264th regular meeting of the Anthropological Society was held Tuesday, May 4, 1897. Dr. George M. Kober read a paper entitled 'Progress and Achievements in Hygiene,' in which he gave a résumé of the various attempts to introduce sanitary measures, either general or specific, in various countries at divers times, and noted the good results which followed, many of them being permanent in character.

The marked immunity of the Jews was noted, and how it had continued even to the present day, as evidenced by the extremely low mortality; this condition of affairs was attributed not so much, to rigid enforcement of the laws of health prescribed by the Hebraic law as to their racial sobriety producing of a sturdy constitution, capable of resisting disease to a considerable degree. The author then recited incidents tending to prove the assertion that the desire to prevent diseases was innate in the human race. The relation of medicine and religion, the medicine dance, the disposal of the dead, cremation and other forms of primitive practices were given in detail.

A 'General Discussion upon Sanitation among Primitive Peoples' then followed. Mr. Geo. R. Stetson said that in equatorial Africa there was an absence of filth in persons and places, and spoke of the misconception concerning the climatic and physical conditions of Africa. The endemic and introduced diseases were then noted. The general discussion was then taken up by Professor L. F. Ward, Drs. McGee, Woodward, Magruder and McCormick.

J. H. McCormick,
General Secretary.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, JUNE 4, 1897.

CONTENTS:

On Two Forms of Automatic Microtomes: CHARLES SEDGWICK MINOT.....857

XII. Deutscher Geographentag. Jena, 1897: F. P. GULLIVER.....866

Status of Forest Reservation Policy: B. E. FERNOW..868

Current Notes on Physiography:—
Topographical Map of the Geological Survey: The Baraboo District, Wisconsin; Balch on Ice Caves; W. M. DAVIS.....869

Current Notes on Anthropology:—
Ethnography of Madagascar; Studies in Mayan Hieroglyphs; Psychics in the Study of Man: D. G. BRINTON.....871

Notes on Inorganic Chemistry: J. L. H.....872

Scientific Notes and News.....873

University and Educational News.....876

Discussion and Correspondence:—
The Discrimination of Species and Subspecies: J. A. ALLEN, THEODORE ROOSEVELT. *Glacial Man in Ohio:* CLARENCE B. MOORE. *The Smithsonian Institution and a National University:* BENJAMIN IDE WHEELER.....877

Scientific Literature:—
Two Outlines of Psychology: JOSEPH JASTROW. *The Geologic Atlas of the United States*.....882

Scientific Journals:—
The American Journal of Science.....888

Societies and Academies:—
Geological Society of Washington: W. F. MORSELL. *New York Academy of Sciences—Section of Geology:* RICHARD E. DODGE. *The Torrey Botanical Club:* E. S. BURGESS. *Boston Society of Natural History:* SAMUEL HENSHAW. *The Academy of Science of St. Louis:* WILLIAM TRELEASE.....889

New Books.....892

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

ON TWO FORMS OF AUTOMATIC MICROTOMES.

IT is proposed to describe two microtomes, one of which has already been widely used; the other, on the contrary, has been put on the market very recently. The older instrument may be known as the 'automatic wheel microtome;' the new one has been named the 'precision microtome,' and is also planned to work automatically.

A microtome is an instrument of precision, which implies that it must be treated with extreme delicacy and kept most scrupulously clean. It will be found usually, when complaint is made against a microtome, that the complaint is misdirected and ought to be, not against the machine, but against the owner. A modern microtome necessarily has several adjustments, every one of which must be exact and secure. If any one of them is imperfect and insecure; if any of the movable parts are allowed to become corroded, or gummed up with oil, or loose, or clogged with dust or dirt of any kind, the microtome will not and can not work as an instrument of precision.

The knife used for cutting ought to be regarded as an integral part of the microtome, and as its most delicate and easily injured part. In accordance with this view, there has been added a description of a new form of knife, which offers certain substantial advantages.

I. THE AUTOMATIC WHEEL MICROTOME

This instrument was designed in 1886 and was first made by G. Baltzer, the trusted instrument-maker of Professor Carl Ludwig. Baltzer, who died recently, continued for many years to furnish apparatus for the Physiological Laboratory in Leipzig, and had, therefore, unusual experience in the practical construction of new instruments. The first automatic microtome made by him is still in active service in my laboratory. Experience suggested various minor improvements, which have contributed to render the microtome more accurate and more convenient. Besides the changes which I have introduced, there have been several proposed by Professor Wilhelm His and by Dr. Spalteholz, which have proved especially valuable. It is remarkable that very few available suggestions have been made by the mechanics who have manufactured the machines hitherto. The most important change, I consider, to have been the increase in the heaviness of the construction, for it secures greater rigidity, a quality of great importance when very thin sections are desired.

Mr. Francis Blake, of Weston, Massachusetts, is engaged in improving the mechanical construction of the instrument. The changes proposed by him will prove, I think, of great value.

The automatic microtome is now made in Boston, by the Franklin Educational Company; Leipzig, by E Zimmerman; Paris, by E. Cogit; Cambridge, England, by the Cambridge Instrument Company.

Over two thousand are now in use. I believe that the instruments are in all cases well made. I have not, however, had an opportunity of testing myself those made in England. The first instruments made in America were not wholly satisfactory, but I believe them now to be made in this country fully as well as elsewhere, and there are certain details in the American design, as at present followed, which render it, in my judgment, preferable to the European models. The illustrations give two views of the American microtome, as now made. The general principle of the instrument is to keep the knife fixed, and to move the object to be cut in a vertical direction, supplying it to the knife by an automatic feed. The knife is carried by two upright standards, united by two cross bars; in the American microtome these are all a single casting; in the German they are four separate pieces screwed together, and, therefore, less securely rigid. The two uprights can be adjusted as to their distance from the object to be cut. The object, imbedded in paraffine, is attached to a brass plate, which can be securely clamped at any desired angle in the machine. The motion of the apparatus is imparted by a wheel, which may be turned by hand, or by a water or electromotor, but the hand-power is the most satisfactory. The wheel is made considerably heavier and is better balanced in the American model than in the others, so that the machine works more smoothly and evenly to the sensible improvement of the cutting. The wheel turns the axle to which it is attached, and at the opposite end of the axle is a crank working a slide, which raises and lowers the vertical carriage. This carriage is held by adjustable gibs against the vertical ways; it carries on the side toward the knife the object-holder, with its adjustments to fix the plane of the sections; it also carries the horizontal microtome screw. The head of the micrometer screw is a tooth-wheel, each tooth corresponding to a feed of $\frac{1}{800}$ mm. The screw is turned by a pawl, which acts upon the toothed-wheel; the pawl is worked, as may be readily seen in Fig. 2, by the vertical motion of the carriage, and the number of teeth caught at each rise of the carriage may be varied mechanically from one to six. The American form of pawl is simpler,

more certain and accurate, and less liable to get out of order than the foreign form.

The Zimmerman microtomes are of a very high grade of workmanship, and I can recommend them with confidence, having thoroughly tested them. The Cogit microtome also appeared to me thoroughly good, but I have had no opportunity to test one by prolonged use. Zimmerman has added to the microtome, as made by him, an attachment to give a feed of 0.001 mm., but it seems to me that the addition is of slight value, since the accuracy of the instrument cannot be carried so far, because with vertical ways the precision of movement cannot be made so great. No doubt such sections (of 0.001 mm.) can be made with the machine, but if the object offers any difficulty from its size or its hardness the machine will fail. For very fine work another type of microtome is called for.

The automatic wheel microtome will cause only vexation and disappointment if it does not receive the utmost care. I will, therefore, mention the most necessary precautions. The following are of the first importance:

1. *Keep the microtome perfectly clean* To accomplish this, not only must all dust be removed, but also no oil which has become thick or gummy must be allowed to remain. A special risk comes from the paraffine, small bits of which are very apt to fall upon the instrument, and if they are permitted to lodge on any of the movable parts they may easily cause serious injury and will certainly prevent even section-cutting. Extreme cleanliness is indispensable, and to better secure it the microtome should always be covered when not in actual use.

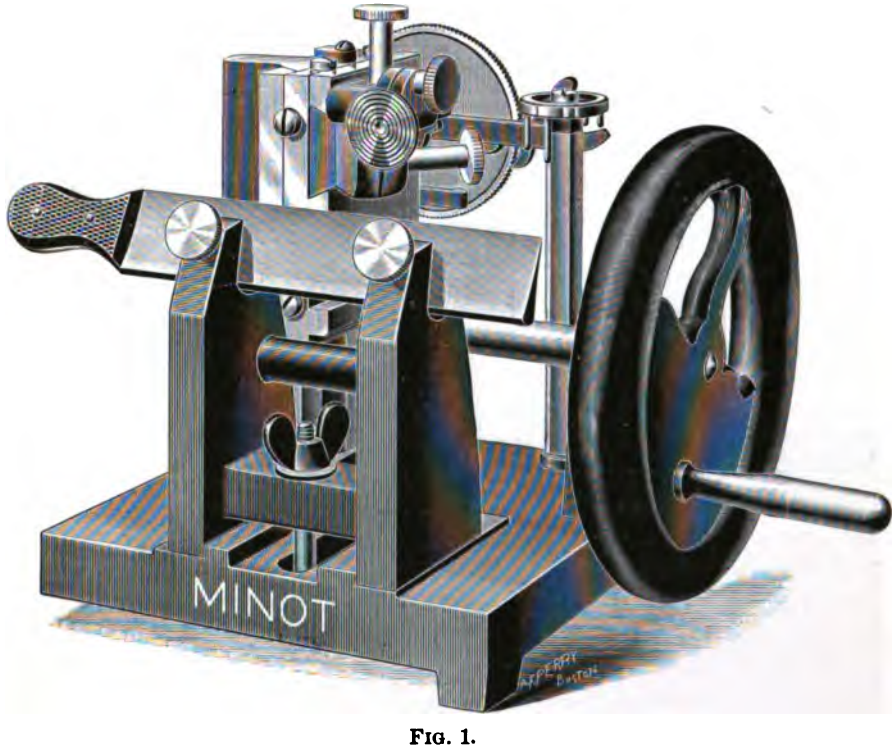

FIG. 1.

2. *Keep the microtome perfectly oiled.* All the movable parts must be well lubricated

with clean, fresh oil. The micrometer screw should be oiled with porpoise oil, which will last for months. For the other parts a light paraffine oil may be used. I have found that which is known to the trade as No. 40 suitable.

3. *All the permanent adjustments must be perfectly set.* Of the permanent adjustments there are two which require more or less constant attention: *First*, the movable gib, by which the carriage is held against the vertical way; that gib should fit as tightly against the way as is compatible with the free running of the apparatus. If this is not done no satisfactory sections can be obtained, because the action will be irregular. *Second*, the split-ring around the neck of micrometer screw must be tightened sufficiently to prevent any back-lash, but not enough to make the screw hard to turn.

4. *All the changeable adjustments must be absolutely firm.* In order to attach the paraffine plate to the movable carriage there is a triple clamp, so constructed as to allow independent movements in three directions. The three screws of the clamp must all be tightened, and novices must remember that a metal screw cannot be tightened with the first turn, but that after a minute or so it can be tightened a little more. The knife is held by two screws, which must also be doubly tightened to ensure the knife being firmly held. In my experience with students, it seems to me that about nine-tenths of the failures to get satisfactory sections are owing to the neglect of the proper clamping either of the knife or the object-holder, or both.

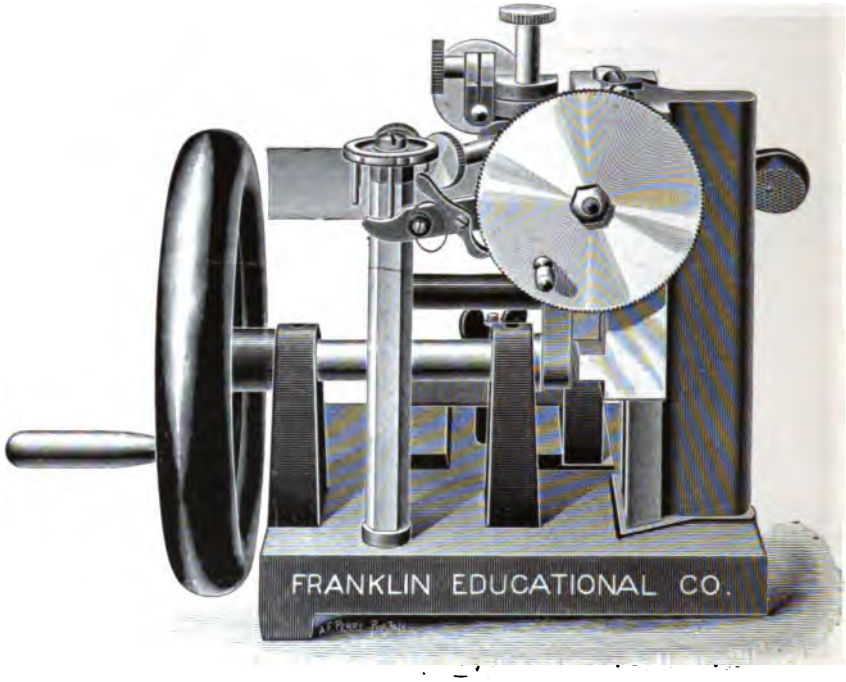

FIG. 2.

5. *Avoid cutting on days when the sections become highly electrified.* Everyone who has done much section cutting of objects imbedded in paraffine has encountered the difficulty of handling sections which have been electrified during the cutting, for the

sections will then jump at any neighboring object, especially of metal, and adhere to it obstinately. Sometimes the force is sufficient to break a ribbon of sections, which will then snap at the microtome and in an instant be clinging to it in a hopeless snarl. The amount of electrification varies from day to day, and there are fortunately days during which the phenomenon is absent. Usually damp days are the best. The cutting of any valuable object should be reserved for one of the favorable days. By laying an inclined plane, some ten inches long, of wood or cardboard, with its upper edge under the knife and its lower edge resting on the table, it will be found that the ribbon of sections, even if electrified, can be handled with comparative safety, for, even if the sections are drawn down by the electrical attraction, they will lodge upon the plane and usually will become either twisted or entangled.

II. THE PRECISION MICROTOME.*

The first object of a microtome is to make sections of even and known thickness; the second object is to make a sections in large numbers of uniform thickness; the third object is to make sections rapidly. Finally, in recent years, there has been a growing and justified demand for microtomes to make good sections of extreme thinness, if possible not over one five-hundredth of a millimeter or two microns (0.002 mm.). Sections of such tenuity and even possibly of less thickness have been made hitherto with the microtomes now in use, and I have not infrequently encountered the statement that the requisite precision was already secured by one or another pattern of microtome. In looking at such sections I have observed in a number of cases that they were much thicker than they were stated to be, and have learned upon inquiry that the scale of the microtome was unknown to the operator. In other cases the sections appeared to be really as thin as stated, but such as I have seen were invariably of minute objects, which offered no real difficulty to fine sectioning. I do not think any form of microtome hitherto constructed can be relied upon to yield sections 0.002 mm. thick of objects that are of even moderate size or that offer much resistance.

The first step was to gain a more definite notion of the practical hints of admissible error. Now, upon trial it was found that sections which vary more than one-tenth from their supposed thickness can, in the case of stained animal (vertebrate) tissues, be readily recognized by the naked eye as uneven. Hence, it is obvious that the thinner the section the less must be the amount of absolute error in the cutting. For example, an error of 0.0002 mm. is the maximum admissible for sections of 0.002 mm. (500 to a millimeter), though a much greater error would not be noticeable in sections of 0.02 mm. Applied to the microtome this means that a roughly made instrument is sufficient for thick sections, but the most perfect construction is necessary to secure a microtome for fine cutting. Besides, for greater mechanical perfection, a new microtome should also strive to be so constructed as to be suitable for both dry (paraffne) and wet (celloidine) cutting.

It seemed to me that progress might be made on the basis of the following principles:

First: The object should be supported directly under the knife, and upon a carriage with a broad base.

Second: The carriage should move upon a horizontal way below the knife.

Third: The object should be fed to the knife by a vertical micrometer screw, which should be arranged to work automatically.

Fourth: The knife should be firmly

*This instrument has been shown at Paris, Liverpool and before the Society of Morphologists at Boston. See Comptes Rendus Soc. Biologie, Paris, 1896, Juin, p. Report British Assoc. Adv. Sci., Liverpool, 1897, p. 979. SCIENCE, N. S., Vol. V., p. 106.

clamped at both ends upon a rigid frame, the frame to be made square so as to allow the knife to be placed in any desired position or at any desired angle.

Fifth: A cup, with a drainage tube, to be placed under the object-holder to collect alcohol and prevent its falling, while the apparatus was in use for wet-cutting, upon the gears or ways beneath.

About two years ago I consulted with Mr. Edward Bausch in regard to the projected microtome, and we have worked in collaboration to solve the many problems involved in the practical application of the five principles enumerated. It is a pleasure to state that Mr. Bausch has contributed in many and in essential ways to the plan of the microtome, and its successful production is largely due to his zealous interest. He has certainly spared neither time nor pains to secure a good result.

In designing the new microtome precision was made the prime object. The usual sources of error are: (1) in the bending of the knife; (2) the yielding of the object to be cut, chiefly because it is at the end of an arm which acts as a lever; (3) the 'jumping' of the sliding gear. All these defects are at their maximum in the Rivet type of microtome, of which the best known form is the Heidelberg or Thoma-Jung. It is believed that in the new microtome these three sources of error are materially diminished.

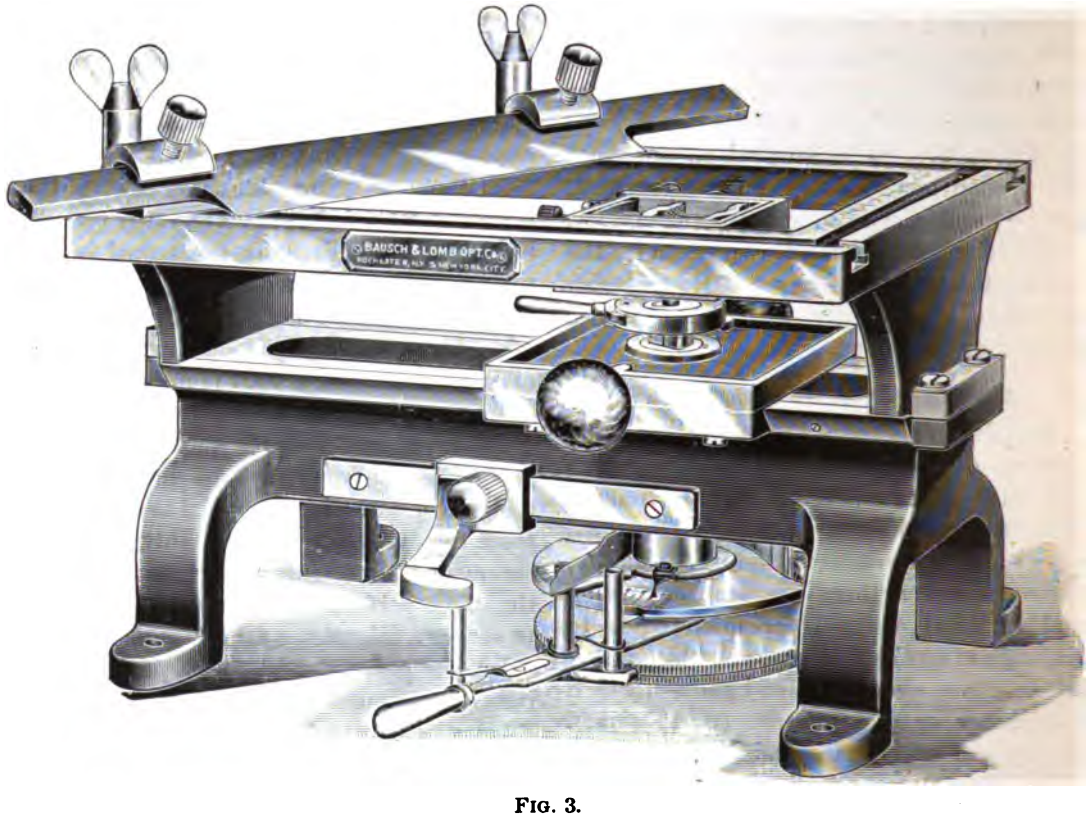

Fig. 3.

The accompanying illustration, Fig. 3, affords a general view of the Precision Microtome. The uppermost part of the microtome is a square frame heavily made

of cast iron. The knife is held by two clamps, which can be fastened at any point in the slots upon the upper part of the square frame, so that the knife may be either at right angles or at any desired inclination to the direction of the draw in cutting. As the knife blade is thick and strong, and is clamped at both ends, the cutting edge is rendered almost immovable. Underneath the knife-bearing frame are the two horizontal ways, upon which runs the sliding carriage. It will be noticed that the general construction of the whole machine resembles in principle a lathe-bank. The carriage itself is a broad platform with a raised rim; by its size the danger of tilting in any direction is rendered small; the raised rim serves to retain the alcohol, which drips from the specimen above and prevents its falling upon any of the working gear; from the surface of the carriage the alcohol is drained off by a tube, which, being upon the further side of the instrument, is not shown in the engraving. The object-holder is a square box, and is so devised that it can be readily lowered or raised, and renders it easy to adjust the plane of the section after the object has been clamped in. As the object-holder is supported firmly immediately under its own center, the possible leverage is minimized. The object is raised by a micrometer screw, which works with a vertical tube which descends from the middle of the carriage between the two horizontal ways. At the bottom of the screw there is a large toothed-wheel, which is utilized to feed the screw automatically. The toothed-wheel is turned either to the right or left, as desired, by means of the lever, the long handle of which is seen projecting at the bottom of the figure. The figure also shows the lever resting against a vertical bar. When the carriage is moved the micrometer attachment and the lever are moved along with it, and when the lever strikes against the vertical bar it is forced to turn the toothed-wheel and so work the feed of the apparatus. It will be noticed that the vertical bar is borne upon an arm, which can be slid to and fro upon the body of the microtome and clamped at any point as wished. By these means the lever can be set in action at any desired point of the excursion of the movable carriage.

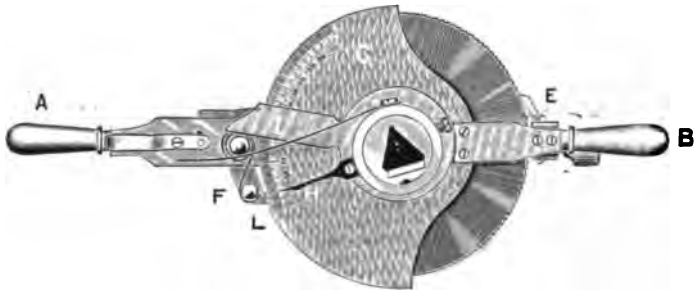

FIG. 4.

The arrangement for the automatic feed is similar to that employed in de Groote's microtome. As modified for the needs of the 'Precision Microtome,' the device seems to me to leave little to be desired on the score of either convenience or accuracy. Figure 4 gives the plan of the arrangement. The following description of the feed was drawn up by Mr. Bausch:

"The feed arrangement consists of a micrometer screw, having pitch of 0.5 mm., which elevates the object-holder.

"The motion of the screw is transmitted

to the object-holder through a triangular bar, moving smoothly but firmly in a triangular channel, all lateral motion being eliminated by means of a wedge.

"The construction of this part is exactly the same as that used in the fine adjustment of the microscope. (The triangular bar, wedge and bearing are shown in section in the figure.)

"The micrometer screw is provided at its lower extremity with two metal discs in contact, each having one hundred serrations, the acute angles of the upper disc pointing to the right, and those of the lower to the left. The discs are revolved by means of the lever A, which is pivoted loosely on the axis of the micrometer screw, and which is provided with a pawl, F. F is actuated by the small lever shown on the upper surface of A, so that when the actuating lever is thown to the left, F engaged the teeth of the upper disc, and motion of A to the right elevates the object. The spring rachet, E, prevents any backward motion of the screw head and may be disengaged by means of the thumb screw shown.

"After the screw has been fed up to its greatest extent it is quickly returned by moving the actuating lever to the right, when a small pawl, not shown in the figure because beneath the lever, engages the teeth of the lower disc, and motion of A to the left depresses the object carrier. The *amount* of elevation of the object is concontrolled in an entirely automatic manner.

"The stop I is a rigid attachment and is provided with an index, H. C is a graduated disc pivoted around the axis of the feed and movable by means of the lever, B. Two graduations on C correspond to one of the notches on the disc of the micrometer screw.

"Beginning at zero of the scale, the circumference of C has an inclined plane for the following purpose:

"The disc C being set so that the number indicating the desired thickness of section is opposite the index, the stop post of A is held against the stationary stop, I, by the long spring; F engages a tooth of the upper disc. If now the lever A is moved to the right, F will continue to engage the tooth of the disc until the guide post, L, comes in contact with the inclined plane on the margin of C, which disengages the pawl, F, from the tooth of the disc exactly at the zero point of the scale. It will thus be seen that no matter how far A may be moved, F will act only through a certain prescribed distance, governed by the position of the disc C, and that the amount of elevation of the object is definitely indicated by the position of H on the scale.

"The operation of the feed arrangement may be made either automatically or by a separate movement of A by the hand; the former for serial and ordinary sectioning; the latter for very thick sections or for sections of irregular thickness.

"If automatic feed is desired, the sliding stop on the base of the microtome frame (see figure) is adjusted to act as a stop for A, carrying it through the required arc, when the sliding carriage is moved forward and backward for cutting the section.

"When the hand feed is used, the adjustable stop may be slid back out of the way, or removed from the instrument altogether.

"The advantages of this feed may be summed up, as follows:

"Simplicity.

"Great accuracy.

"Short feed (distance object is elevated by movement of one tooth of the disc, being 2 microns).

"The feed entirely independent of amount of motion given to feed lever, A.

"Convenience of setting for any desired thickness.

"Automatic or hand feed at will.

"Object elevated when object carrier is

being returned to position to begin cutting and after the object has passed under the knife.

"Ease with which feed screw may be returned when fed up to its full limit."

III. A NEW FORM OF MICROTOME KNIFE.

To satisfactorily sharpen a knife for fine section-cutting is a diffiulty, which we all have learned to estimate as serious. The valuable article by Moll on sharpening in the *Zeitschrift für Wissenschaftliche Mikroskopie* in 1892 (Bd. IX, p. 455) called my attention to various possibilities, and at my request Dr. F. S. DeLue tested a number of methods. These tests resulted in the adoption of plate glass and diamontine powder mixed with water as the best means of securing a satisfactory cutting edge. Plate glass seems to have been used from time to time, and is especially recommended by Moll. The use of diamontine powder was suggested by Dr. Lotze (Johns Hopkins Hospital Bull., Dec., 1894).

Having at command a satisfactory method of sharpening, it soon became evident that the knives should have a form to which that method could be applied conveniently. It was necessary that the knife should be: 1, rigid; 2, slightly hollowed on both sides; 3, of such shape that it could rest its whole length on a plane surface; 4, that there should be no edge to be sharpened, except such as could be used for actual cutting. These four requirements are met by the pattern illustrated in Fig. 5, already made in two sizes, the larger being intended for the '*Precision*,' the smaller for the '*Automatic wheel*' microtome. In both knives the essential features are the same, the proportions only being different. The larger knife is 330 mm. long; its cutting edge is 185 mm. long, and it is 12 mm. thick at the back. The smaller knife is 160 mm. long; its cutting edge 85 mm. long, and it is 10 mm. thick at the back. These knives have the handles of the same cross section as the blade; they are alike on both sides, being slightly concaved. A knife of this pattern can be laid upon a glass plate, upon which a little water with diamontine has been rubbed; the knife rests upon its cutting edge and upon its back edge, and may be perfectly sharpened without any special technical skill by simply passing the blade to and fro, resting alternately first on one side, then on the other, until the entire edge is completely polished.

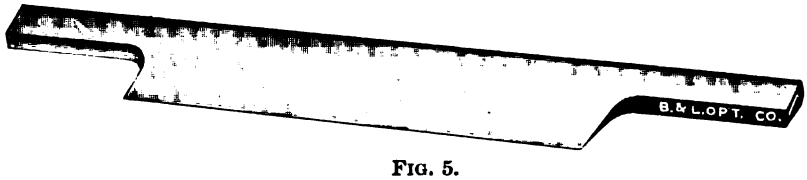

FIG. 5.

The knife is then removed, thoroughly cleaned, the glass plate also cleaned and the edge finished by polishing on the glass plate with water only. The glass plate by itself will remove any wire edge which may be left by the diamontine powder.

It often requires considerable time to get the first edge on a new knife, for the knives as furnished by the manufacturers are never quite straight, but after the edge has been once obtained it is easily kept in condition, provided that it is not allowed to become nicked or dented through careless handling.

There is one precaution in the use of this method of sharpening which cannot be taken too conscientiously, namely, to keep the glass plate while in use absolutely free from dust and dirt of every description;

the glass itself must be kept absolutely clean, only *filtered* water to be put upon it, and the diamontine must invariably be protected from the dust.

A knife is sharpened when its edge appears smooth and straight under a magnifying power of 40–50 diameters.

When section cutting began a razor was the sharpest of familiar tools, and so it happened that for years razors were used not only for free-hand cutting, but also for microtomes. When knives began to be made specially for microtomes the razor type of thin blade was followed. We now know that the razor is the worst possible model for a microtome knife and that the chisel pattern is infinitely superior, because a thin blade is elastic, while a thick blade is rigid. With small objects or soft tissues the resistance may be so slight that the razor will cut them satisfactorily. Or, again, if the sections are thick the error of the razor may be unimportant, but for very thin sections, or for cutting difficult objects, the new heavy type of knife may fairly be said to be indispensable.

Charles Sedgwick Minot.

Harvard Medical School.

XII. DEUTSCHER GEOGRAPHENTAG, JENA, 1897.

During the late Easter vacation there were gathered together, in the charming little university town of Jena, a large number of the German Scientists whose work touches more or less closely the field of geography. When one considers the variety of subjects represented he must put the question: What is Geography?—What has it been in the past and to what future fields is the present aspect of the science leading. To consider this theme, at length, is not the intention of the writer in giving a short account of this Congress of German Geographers, but he would like to use this question as a connecting thread in the following lines.

There were nearly 600 members and associates in attendance, making this Geographentag the third largest in numbers of this series of most successful gatherings. Only Berlin and Vienna have had a larger attendance, and so it was said that Jena should be rated as a city with a million inhabitants. All those present were not from Germany, as eleven other nationalities were represented, these justly famous scientific gatherings naturally attracting foreigners. The addresses given are of such merit and given by such men as to induce many to come to hear, but it is not forgotten by the committees in charge that the most important feature of such gatherings is to bring the workers in various fields together, and to give them opportunities for conversation and consultation. The four and a half days were very happily arranged so as to supply a combination of attractions suited to the wants of all.

Under the presidency of Geheimrath Neumayer the members were led to consider the investigation of the region of the South Pole, and were shown that while very little in the way of actual exploration had been done by the commission, which was appointed at the XI Deutschen Geographentag in Bremen, still a large amount of material had been collected, and the way was being prepared for pioneer work in this little mapped region. Outline cartography, or the separation of land from water areas, is one of the early stages of geographic science. It is naturally followed by expeditions over land in the less known portions of the continents. This second phase of the science was represented at Jena by the three following papers: Expedition to Central Brazil, by Dr. Herrmann Meyer, of Leipzig; German Investigations in Asia Minor, by Dr. Heinrich Zimmerer, of München; Journey through Syria and Ana-

toila in 1895, by Roman Oberhummer, of München. Many interesting items of geographic news were brought back by these travelers, but they will not be enumerated here, for this sketch cannot go into many details. Let us, therefore, note the methods of the present explorations as contrasted with those of the past. When there were extensive areas of unexplored territory it was most inviting for an ambitious man to attempt to cover as much area as possible. How thin a covering of the ground was made by these early travelers is well known by any one who has tried to find out some particular thing from the accounts of their journeys. The modern traveler must study in more detail a given area of smaller dimensions, or take up some special problem in a larger area. An example is seen in the minute ethnographic studies made by Dr. Meyer in the interior of Brazil.

In America one is apt to look upon the work of the schools in Prussia as so far ahead of American schools in methods of teaching geography as to be almost a model to be followed; but the exceedingly suggestive paper of Oberlehrer Fischer, of Berlin, made his audience feel that there was much cause for instant improvement in the work of the teachers of geography in Prussia. The very valuable statistical tables presented by Mr. Fischer will shortly be published in a separate pamphlet with the text. Professor Dr. W. Sievers outlined a plan of extended excursions with students to teach them geography by a closer examination of typical forms in various regions. For the universities of middle Germany he suggested three trips in successive years, one to the coast, the second to the highland, and the third to the Alps. Professor Dr. J. Palacky, of Prag, spoke of the importance of an herbarium arranged according to geographical distribution of plants for the teaching of geographic botany.

One morning was given up to the discussion of the Geophysical problems of earthquakes and magnetism. Professors Gerland, of Strassburg, and Supan, of Gotha, led the former, and Drs. Ad. Schmidt, of Gotha, and E. Naumann, of München, the latter. Many others took part in the discussion. Professor Supan outlined a plan for the more systematic observation and recording of the local and more widespread earthquakes. Governmental aid is to be asked in the carrying out of some such plan. These problems bordering upon physics and geology would hardly be considered geographic in America. As one man expressed it at Jena, "The subjects of earthquakes and magnetism are considered under geography in Germany only because they belong nowhere else." Many other subjects from various sciences may be made geographic by considering them in relation to their distribution over the earth.

There were three papers in the field of biologic geography: 'Australian Fauna,' by Professor Dr. Semon, of Jena; 'The distribution of the various animals used in transportation and their dependence upon geographic conditions,' by Dr. Ed. Hahn, of Lübeck; 'The animals upon the island Borkam, particularly in regard to important observations for the geographic distribution of animals,' by Professor Dr. O. Schneider, of Dresden. Professor Semon presented tables showing the proportions of species living only in Australia and those living also in other neighboring lands. Dr. Hahn made a most interesting presentation of the marked geographic control shown in the distribution of the various beasts of burden in use in different parts of the world. Professor Schneider pointed out the importance of making a thorough study of the species inhabiting the Frisian islands belonging to Germany, before the same are connected with the mainland artificially, as is contemplated by the government.

Professsr Dr. J. Walther gave the only physiographic paper of the week. He described in most picturesque language the present forms of the Thüringer *horst*, and showed how much more the form of this elevated block, or *horst*, of the Thüringer Wald, is dependent upon the series of northwest-southeast faults of late Tertiary to recent time than upon the system of the eastnortheast-westsouthwest folds of Carboniferous time. Where, however, these planed folds of the Erzinian system are resurrected by the stripping off of the Mesozoic strata the forms are in great measure controlled by the earlier made folds, as, for example, in the Cambrian ridge, Lange Berg.

Mathematical geography was also represented by one paper: 'The shadow cast by mountains and its effect in the Alps and in the mountains of middle Europe,' by Dr. K. Peucker, of Vienna. The mathematical calculations were too intricate for the audience to follow, but the graphic diagrams, illustrating the effects of varying trends and elevations in different sections, were followed attentively. One of the excursions was to the immense plant for the manufacture of optical instruments belonging to Carl Zeiss, where applied mathematics is used to the great advancement of science. The various delicate processes connected with the grinding and polishing of the many forms of lenses, as well as the forging and cutting of the metal portions of the instruments, were all shown and explained. The new tele-objectives for photographing at a distance or in places difficult of approach were examined, and the wonderful details seen in photographs made several kilometers distant were duly admired. The opera glasses with long tubes, capable of being extended in any direction in a plane at right angles to the line of sight, will no doubt be highly appreciated in the United States, where theater hats are not as yet out of date.

The longest excursion of the week was made to Weimar, where a special performance for the benefit of the members of the Geographentag was given in the theater, which is under the patronage of the Grossherzog and is closely associated with the lives of Goethe and Schiller. The points of historical interest in Weimar were opened to the guests in the same way that they had been in Jena. Among the other excursions were those to the battle field of Jena, to the Ilm graben, to the Saale valley, to the glass works, as well as visits to the collections in the university, the specimens brought from various deserts by Professor Walther, the zoological and other University departments. Walking parties in the beautiful suburbs of Jena and some social gathering every evening brought the workers in geography into closer touch with one another. Geographers as well as other men in Germany are particularly social and companionable after saying 'prosit' over their beer.

Geography in Germany attracts men. The average attendance at the monthly meetings of the Gesellschaft für Erdkunde in Berlin is 400–600. The study of the earth in its relation to man should attract men; nothing could be more natural. As a science, geography should be made more systematic; scientific, but clear and simple so that children may understand; comprehensive, since man is so many-sided; and yet trimmed of all irrelevant matter. Let us strive toward a high-ideal development of geography in America.

F. P. Gulliver.

Geographisches Institut, Wien.

STATUS OF FOREST RESERVATION POLICY.

By the vote of the Senate, on May 27th, adopting the conference report on the Sundry Civil Appropriation Bill, the United States government took one more forward step in establishing a forest policy; the

adoption of the report by the House of Representatives and the signing of the bill by the President being a foregone conclusion. That bill contains an amendment (based upon the so-called McRae Bill, the measure advocated by the American Forestry Assocation) under which the Secretary of the Interior is authorized to institute a forestry service for the forest reservations which had been established prior to the late proclamations by President Cleveland and such as may be made hereafter. These latter reservations, made upon the recommendation of the Committee of the National Academy of Sciences, have by this amendment been suspended, *i. e.*, the operation of the proclamations has been annulled until March 1, 1898, and until that time the lands embraced in these reservations are to be returned to the public lands open to entry and subject to the general land laws.

A survey of all the reservations, showing the distribution of the forests, by the Geological Survey is ordered and an appropriation of $150,000 made for it, the supposition being, although not definitely expressed in the bill, that such surveys or sufficient portions of them can be accomplished before March 1, 1898, and give information as to existing conditions which will enable the President to entirely revoke or else intelligently modify the boundaries and extent of the reservations, power to do so being expressly given in the bill.

This entire legislation is, to be sure, a compromise measure and extremely crude and imperfect, having been precipitated by the strenuous opposition of the Western delegates to the reservations made by Mr. Cleveland's order. These, it is claimed, have been established hastily, without sufficient knowledge and discrimination, without opportunity for interested parties to be heard, embodying, at least in some cases, large areas that should not reasonably have been included. To the last the Western representatives acted as a unit in discrediting in every way the hasty action of President Cleveland and his advisors, and in insisting that the proclamations be unconditionally and forever annulled.

In spite of the crudities and the emasculated condition of the legislation which finally saved the reservation policy and secures the first beginnings of a forestry service, it must be welcomed as such a first step, which may gradually be developed into a creditable forest administration. Thus, while it appeared a misfortune that the Committee of the National Academy advocated the extension of forest reservations before having submitted their report on the necessary administration of the same, it may have proved a blessing in disguise.

There is no specific appropriation with which to inaugurate the forestry service, unless the $90,000 appropriated for Special Timber Agents is construed to be applicable.

The manner in which the Geological Survey will acquit itself of its difficult task of segregating the lands which are properly to be reserved or excluded from reservations which will have to do with allaying the opposition of the Western States and forwarding the establishment of a sound forest policy.

B. E. FERNOW.

CURRENT NOTES ON PHYSIOGRAPHY.

TOPOGRAPHICAL MAPS OF THE GEOLOGICAL SURVEY.

BY recent Congressional enactment, the topographic as well as the geologic maps and atlases of the U. S. Geological Survey may be sold to the public. Heretofore the distribution of the topographic sheets has been somewhat irregular; and, although a few years ago the statement was authorized that copies of the maps would be distributed to schools for use in teaching geography

as long as the printed editions lasted, this proved an insufficient means of placing them in the hands of the public. They are now sold at five cents apiece for small orders, or at two cents each in orders of a hundred sheets or more, whether for the same or for different sheets. Two dollars for a hundred maps is certainly a merely nominal price. Nine hundred sheets have been printed. Lists of the maps may be had on application to the Director of the Survey. Orders for sheets must be accompanied by money order or cash for the exact sum called for.

Among the newer sheets may be mentioned Lexington and Stromsburg, Nebraska, including parts of Platte river sprawling on in tangled channels its sandy bed, with dissected uplands on either side of its broad valley floor; Pasadena, Cal., showing what appears to be a great alluvial fan spreading out from the base of the San Gabriel mountains; Chester, Pa., with a number of sub-parallel, transverse streams draining the 'stripped belt' of old-land marginal to the New Jersey coastal plain, as if they had been set on the old-land rocks by superposition when the plain stretched further inland. Many others are of equal interest. The San Mateo, Cal., sheet (part of the San Francisco peninsula) is notable for the delicacy of its contour lines, which appear to show much more detail than usual and in this respect stand in strong contrast with the free-hand contours on the earlier Fort McKavett, Texas, sheet. The same is true of the contrast beween the irregular contours on the Pueblo, Col., sheet, edition of 1896, and the over-generalized contours of the same sheet, edition of 1891.

THE BARABOO DISTRICT, WISCONSIN.

"The drift phenomena in the vicinity of Devil's Lake and Baraboo, Wisconsin," (*Chicago Journ. Geol.*, V., 1897, 130–147) is a paper based on field work by students of the University of Chicago, under the direction of Professor Salisbury. The region is one of varied attractions, including the Baraboo ridge, an ancient quartzite monadnock on the peneplain of pre-Cambrian North America, submerged and buried in early paleozoic sediments, now exposed again by weathering and denudation, and thus, like other ancient fossil forms, organic or inorganic, presented to us for study. The ridge is irregularly traversed by the terminal moraine of the Green Bay glacial lobe, and the irregular path of the limiting drift ridge is the subject of special study. Devil's Lake lies in a deep gorge, excavated in preglacial time (probably for the most part, Tertiary) across the quartzite ridge; the agent of excavation being apparently the Wisconsin River, now displaced by heavy moraines in the gorge. The quartzite ridge was somewhat sculptured in pre-Cambrian times, for its slopes still hold a sandstone filling in ancient ravines; but we question whether the gorge was so largely of ancient origin as is implied (p. 141). The greater part of its walls are free from sandstone; and, moreover, it would be altogether unlikely that an ancient gorge, refilled during burial, should have been again discovered and occupied by a superposed river.

BALCH, ON ICE CAVES.

E. S. Balch, lately President of the Geographical Society of Philadelphia, has for some years made a special study of ice caves, and now presents a summary of his observations and researches (Ice caves and the causes of subterranean ice, Journ. Franklin Inst., Philadelphia, March, 1897). The popular belief that ice forms in these caves only in summer is combatted. This idea seems to be based on the fact that in summer the air of a cave feels cool, while in winter it feels warm; but this is only by

way of contrast with the external air, and not at all indicative of actual temperatures. Caves are coldest in winter, but if no water then enters, the formation of ice is delayed until milder weather outside thaws the surface ice or snow. The fact that ice caves are unknown in regions where the ordinary winter temperatures is not below freezing is taken to prove that their true cause is the most manifest one, and that the ice is not due to reduction of temperature by evaporation, and especially that it has nothing whatever to do with a lingering of the glacial period underground. Further details are promised in a later publication.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

ETHNOGRAPHY OF MADAGASCAR.

Two interesting articles on the above subject may be compared, with special reference to the ethnic position of the Hovas.

The one is by Mr. W. L. H. Duckworth and appears in the *Journal Anthropological Institute*, February, 1897, on some skulls from Madagascar in the Museum of Cambridge University. His conclusion from his very careful measurements is that the Hova skull finds its counterpart in the Borneo, therefore Malay type, while those from the Betsileo and Betsimisaraka tribes have marked African traits.

This is in accordance with the general opinion that the Hovas are of Malayan origin. Yet Professor Letourneau, in the Bulletin of the Paris Anthropological Society, throws overboard all the evidence, linguistic and physical, which attaches the Hovas to the Malayan stock, and claims them as purely African, along with the other natives of the island. His arguments are too hasty to carry conviction, and it cannot be said that he has seriously shaken the prevailing opinion.

STUDIES IN MAYAN HIEROGLYPHS.

Two short but valuable articles have recently been published by Dr. Förstemann; the one, the sixth number of his series 'Zur Entzifferung der Mayahandschriften;' the other a paper in *Globus*, Bd. LXXI., No. 5. The latter takes up eight glyphs, and sets forth their relations in the Dresden Codex, and suggests what they mean, or, what they *cannot* mean, for the logical process of exclusion is here of great use.

In the former article he examines the passage of the Dresden Codex which covers the upper thirds of pages 31 and 32. There is evidence, which he mentions, that to the writer of the Codex this was an important paragraph. It deals with large numbers, and not with past or present, but future time. It can, therefore, be nothing else than a prophecy or forecast. What was connected with such a calculation can now be only surmised, as this portion of the literature was transmitted orally. Incidentally (p. 4) it is shown that the calculations of the Dresden Codex date from an epoch anterior to those found on the latest sculptures of Copan.

PSYCHICS IN THE STUDY OF MAN.

NOTHING could be more proper than to include in an anthropological library the 'Proceedings of the Society for Psychical Research,' although it has a queer repute for ghost hunting, etc. The address of its President, William Crookes, F.R.S., is a pamphlet well worth reading and thinking about by the most physical anthropologist. It is a study of the effects of environment on man, considering how the world would look to him if he was the size of a mite, or, on the other hand, as tall as a tree; how he could be influenced by an increase or decrease in the power of gravity, and what might happen to him if he could manage to perceive the millions of vibrations which

now pass through him without his knowing anything about them.

Such studies ought, indeed, to be the foundation of the science of man, involving, as they do, the recognition of his limitations and also his incalculable capacities. It is foolish for scientific men to reject or neglect them on the ground that they are 'visionary' or 'spiritualistic.' What we want is to pursue knowledge in every direction, and to its limits, if we can.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

In many of the acids, especially of the less strongly negative elements, the oxygen may be replaced in whole or in part by fluorin, a pair of fluorin atoms taking the place of each oxygen atom. This is true of the borates in the third group, all the acids of the fourth group except the carbonates, the vanadinates, columbates, tantalates, arsenates and antimonates in the fifth group, the chromates, molybdates, tungstates and uranates in the sixth. Attempts have been made by Weinland and Lauenstein to enlarge this list and their results are given in a recent *Berichte*.

By the action of hydrofluoric acid on the iodates, difluoriodates were formed, of the formula KIO_2F_2, $NaIO_2F_2$ and $NH_4IO_2F_2$. These salts are comparatively stable when dry, but are decomposed readily by moisture. Efforts to form fluo-periodates, fluo-manganates and fluo-tellurates have thus far been unsuccessful.

The ordinary cadmium sulfate crystallizes with 8/3 H_2O, while the sulfates of magnesium, zinc, iron, nickel, cobalt and manganese contain seven molecules of water of crystallization. Cadmium sulfate, however, forms double sulfates isomorphous with the double sulfates of the others. Mylius and Funk have just succeeded in obtaining a cadmium sulfate with the normal amount of water. A solution of the salt, saturated at 70° is suddenly cooled to —20°, and by agitation a cryohydrate crystallizes out. When the temperature is then allowed to slowly rise, the cryohydrate melts, but leaves a granular deposit of crystals sometimes several millimeters in length, of $CdSO_4$, $7H_2O$, cadmium-vitriol. The crystals are, however, very unstable.

The same *Berichte* contains two additional papers by Professor Söderbaum, of Gothenburg, on the acetylid of copper. It was recently mentioned in this column that he had formed a complex compound by the action of acetylene on an ammoniacal solution of copper sulfate. He now shows that by carrying on the action in quite dilute solutions in the cold, the precipitate contains two atoms of carbon for every atom of copper, and he takes as its formula $C_{24}Cu_{12}$, H_2O. The substance is similar to the one formerly described as obtained in a hot solution, but is rather more explosive, and the humus-like compound formed by its treatment with acids is richer in carbon. Professor Söderbaum proposes this method for the quantitative estimation of copper, as well as its quantitative separation from zinc.

A new element, Bythium, is announced in the *Electrochemische Zeitschrift* by Theodor Gross. A fused mixture of silver sulfid and silver chlorid is electrolyzed in a nitrogen atmosphere, using platinum electrodes free from iridium. In the melt is found a dark gray powder, insoluble in aqua regia and in ammonia. Fused with alkaline carbonate it gives a melt soluble in hydrochloric acid, from which hydrogen sulfid gives a brown precipitate. The yield of the new substance is 5% of the original sulfur used. From the fact that there is a corresponding loss of sulfur, the author considers that this bythium is formed by the decomposition of sulfur, though he admits that since there is a small (3%) loss of chlorin

in the electrolytic reaction, it is possible that bythium may be formed by the decomposition of chlorin. An atomic weight determination will be looked for with interest.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE committee on international mails of the postal congress has decided that natural history specimens and articles for scientific collections be admitted to the mails as samples. This will permit of their being sent at the rate of one cent for every two ounces, whereas at present it is necessary to pay five cents for each half ounce or fraction thereof. It will be remembered that this amendment to the regulations of the Universal Postal Union was proposed at the Leiden meeting of the International Zoological Congress at the instance of Dr. Charles Wardell Stiles, and its adoption has been urged by many men of science and scientific associations.

IN the House of Commons, on May 27th, the President of the Board of Trade, Mr. C. P. Ritchie, introduced a bill to legalize the metric system of weights and measures.

TWO fine specimens, male and female, of the rare West Indian seal (*Monachus tropicalis*, Gray) have been received at the National Zoological Park. They were captured on the 11th of May on Campeche Bank, southern part of the Gulf of Mexico.

ON the occasion of a recent excursion of the geology classes of the University of Alabama, in charge of Professor Eugene A. Smith, the public spirit and liberality which are characteristic of the authorities of the Louisville and Nashville Railroad, were exemplified in placing at the disposal of the class a special train, by means of which the boys were enabled to visit all the mines, quarries and other places of interest along the mineral branch of this great system.

THE will of the late Judge John Lowell, of Newton, Mass., gives $3,000 to the American Academy of Arts and Sciences.

IT is reported that some of the heirs at law are contesting the will of the late Alfred Nobel, and that this will delay the distribution of the great prizes established by him.

BY the will of the late Charles F. Lawrence the town of Pepperell, Mass., receives $100,000 for the establishment of a library and art gallery.

THE Council of the Royal Society has recommended for election the following fifteen candidates: Dr. Robert Bell, Assistant Director of the Geological Survey of Canada; Sir William Broadbent, a London physician and neurologist; Dr. Charles Chree, Superintendent of the Kew Observatory; Mr. H. J. Elwes, known for his contributions to ornithology and entomology; Dr. J. S. Haldane, lecturer in physiology at Oxford; Dr. W. A. Haswell, professor of zoology in the University of Sydney; Mr. G. B. Howes, professor of zoology in the Royal College of Science, London; Dr. F. S. Kipping, known for his researches in chemistry; Mr. G. P. Mathews, professor of mathematics in the University College of North Wales; Mr. G. R. M. Murray, the botanist; Mr. F. H. Neville, the physicist; Dr. H. A. Nicholson, professor of natural history in the University of Aberdeen; Mr. J. M. Thomson, professor of chemistry in King's College; Mr. F. T. Tranten, the physicist, and Mr. H. H. Turner, professor of astronomy at Oxford.

THE American Philosophical Society, of Philadelphia, has elected the following foreign members: Lord Lister; Professor H. C. Röntgen, Würzburg; Dr. Fridtjof Nansen; Professor Theodor Tschernyschew, of the Geological Survey of Russia, and Professor A. Karpinski, Director of the Geological Survey of Russia.

DR. A. FISCHER VON WALDHEIM, professor of botany in the University of Warsaw, has been appointed Director of the Botanical Gardens of St. Petersburg.

IT is proposed to erect a monument to the late Professor Anatole Bogdanov, the eminent Russian anthropologist and naturalist, and at the same time to endow a prize for scientific work in Moscow University to bear his name.

AT the annual meeting of the Brooklyn Institute on May 28th Professor Shaler, of Harvard University, made an address in memory of Agassiz.

Professor Josiah Royce, of Harvard University, has been invited to deliver next year the Gifford Lectures at the University of Aberdeen.

M. Souillart, of the University of Lille, has been elected a correspondent in the section of astronomy of the Paris Academy in the place of Dr. Gyldén.

The *Botanical Gazette* states that the Royal Swedish College of Agriculture has conferred a gold medal on Professor Jakob Eriksson in recognition of his studies of the life histories of grain rusts.

Dr. Franz Boas, of the American Museum of Natural History and Columbia University; Mr. Harlan I. Smith, of the Museum of Natural History, and Dr. Livingston Farrand, Columbia University, have left New York for an expedition to the North Pacific coast, the expense of which has been provided for by Mr. Morris K. Jessup and which was fully described in the issue of Science for March 19th.

Nature states that Mr. R. C. L. Perkins, of Jesus College, Oxford, who has been for several years engaged on behalf of the joint committee appointed by the Royal Society and the British Association in studying the zoology of the Sandwich Islands has now returned to England.

At the annual meeting of the New York Electrical Society on May 20th Professor M. I. Pupin was elected President and Mr. George H. Guy, Secretary. There are now 397 members of the Society.

The Russian National Health Society proposes to celebrate next year the 100th anniversary of the discovery of the mineral springs of the Caucasus by a conference on balneology and climatology.

The 66th annual fair of the American Institute will open in Madison Square Garden on September 20th, and will continue for six weeks. Efforts will be made to secure the adequate representation of improvements in machinery made during the past year.

The American Public Health Society will hold its twenty-fifth annual meeting at Philadelphia from the 26th to the 29th of October. Nineteen subjects have been suggested by the executive committee for special discussion.

The American Academy of Medicine held its 22d annual meeting at Philadelphia, on Saturday and Monday, May 29th and 31st. The proceedings included a discussion on the relation of the College to the medical school, in which the Medical School was represented by Dr. Bayard Holmes, of the College of Physicians and Surgeons, of Chicago; the College, by President Warfield, of Lafayette College, and the University by Dr. William Pepper, lately provost of the University of Pennsylvania.

The fourth meeting of the International Congress of Technical Education will be held in London, beginning June 15th.

We have received the first two numbers of a *Natural Science Journal*, published by the Atlantic Scientific Bureau, New Bedford, Mass. We wish the *Journal* much success, but its contents so far are amateurish in character.

Professor H. Kreutz, who, since the death of the late Professor Krueger, has been temporary editor of the *Astronomische Nachrichten*, has been appointed its editor by the Prussian Department of Education.

The bill passed by the New Jersey Legislature establishing a commission to investigate the forests of the State has been vetoed on the ground that the work can best be done by the Geological Survey.

The *New York Tribune* states that Mr. George W. Hammond, of Boston, has given to the Peabody Museum of Harvard University his private collection. It includes large numbers of stone implements from the European countries and many interesting relics of the Colorado cliff-dwellers, as well as specimens from various parts of the United States. It was understood that Harvard College could select all specimens desired for the Museum, and that those not wanted should go to Bowdoin College.

It is announced that a lady has given the sum of £70 towards the purchase of apparatus for the psychological laboratory in University College, London, to which we recently referred. Professor Carey Foster has offered temporary accommodation in the physical department and it is hoped that a lecturer will be secured in October.

WE have already called attention to the appointment of physicians to visit the New York schools. Mr. C. B. Hubbell, President of the Board of Education, advocates the appointment, under the Board of Health, of ten or twelve specialists to examine the eyesight and hearing of the children.

THE daily papers report that an earthquake shock of some severity was felt in Canada and in the northern parts of the State of New York at 10.15 p. m. on May 27th.

LIEUTENANT ROBERT E. PEARY has received leave of absence from the navy for five years. He will go this summer to Whale Sound, where he expects to find several families of Esquimaux who will form a colony further north and will spend the year collecting meat, furs, etc., which colony will be the base of supplies for a further northward advance. Lieutenant Peary will be accompanied as far as Melville Bay by several scientific parties, one under Professor G. H. Barton, of the Massachusetts Institute of Technology, and one under Professor C. H. Hitchcock, of Dartmouth College.

IT is announced that the Thomson Yates Laboratory of pathology and physiology of the medical department of University College, Liverpool, will be oppened by Lord Lister next spring. Mr. Thompson Yates has made further donations for interior fittings and for apparatus, bringing the amount of his gift to $125,000.

THE town of Dundee has decided to establish a bacteriological laboratory, thus granting the petition presented to the Town Council by the District Branch of the British Medical Association.

THE popular magazines for June contain a number of articles of scientific interest. Professor S. P. Langley contributes to *McClure's* an account of the successful working of his aërodome. The *Century* includes three illustrated articles: an account by Professor W. O. Atwater, of the experiments carried out under his direction regarding the use of food in the body; a description of the Harvard Observatory and its branch at Arequippa by Mrs. Todd, and a record of personal experience of home life among the Indians by Miss Alice C. Fletcher. In *Harper's* Mr. H. S. Williams writes on the meteorological progress of the century; in the *New England Magazine* Mr. G. E. Walsh describes forest culture of to-day, and in the *Arena* President David Starr Jordan publishes an article on the Heredity of Richard Roe.

THE Philadelphia Commercial Museum was formally opened on June 2d, in the presence of President McKinley and a number of other distinguished guests. Under the directorship of Professor William P. Wilson the Museum has assumed much importance and now concontains 50,000 exhibits of raw products and many manufactured articles. In addition to the collections of the Museum there is a library especially rich in statistical publications, consular reports, etc., and a Bureau of Information prepared to answer questions on all subjects germane to the scope of the Museum. The Museum is now occupying temporarily the old offices of the Pennsylvania Railroad on Fourth street, but the City of Philadelphia has set aside a site an appropriation of $200,000 for a building. The primary object of the Museum is to bring before manufacturers, dealers and consumers the products of the world, so that they may know what to purchase and what to export. In cooperation with our consular service and with the governments of foreign countries, the Museum will undoubtedly fulfill an important mission, not only for commerce and manufactures, but also for science.

THE first of the two annual conversaziones of the Royal Society was held on May 19th. Among the exhibits described in the English journals were the following: The new process (Dansac-Chassagne) of producing photographs in color, still kept secret, was illustrated in a series of prints in the various stages of treatment by Sir H. Truman Wood. In regard to recent work with the X-rays Mr. A. A. C. Swinton showed his new focus tubes, in which the distance between the cathode and anticathode may be adjusted so as to allow the production of rays of a maximum penetrative value. Mr. Heycock and Mr. Neville showed photographs when the X-rays had been allowed to pass through a sodium gold alloy, showing separately the crystals of gold (opaque) and of

sodium (transparent) existing in the alloys which otherwise appear to be homogeneous. Interesting results of the application of photography were shown in a somewhat similar line of research by Professor Roberts-Austen, who, by means of a microscope and camera and a highly magnifying apparatus, demonstrated the existence of minute diamonds (carbon crystals) in steel. A series of photographs was shown by Professor Norman Lockyer, the diagrams affording testimony of the value of the spectroscope and photography in enabling a simple classification of the stars to be made based upon their ascertained chemical composition. Photographs of the moon were exhibited by the Astronomer Royal. M. Guillaume performed an experiment showing the practically non-dilatable character of nickel steel on heating; its application to pendulums is thus suggested. The diffraction kaleidoscope exhibited by Mr. C. P. Butler used the pure spectrum of white light, the colors being reflected at a great number of angles. The Marine Biological Association's exhibit included marine animals illustrating 'commensalism,' a term used to indicate the constant association of animals with one another often for mutual advantages. Professor Oliver Lodge gave a demonstration of Zeeman's discovery of the broadening of spectrum lines by the action of a magnetic field on the source of light. A sodium flame was placed between the terminals of a powerful magnet. On turning on the current the normal bands become double, triple, or even quadruple. Some excellently mounted preparations shown by Dr. Kanthack illustrated the mode of action of the Tsetse fly. Mr. E. Edser and Mr. H. Stansfield exhibited apparatus showing the phase change of light reflected at a glass-silver surface. The apparatus is a modification of Michelson's differential refractometer, the interfering rays being reflected at the back surfaces of the end mirrors. Mr. C. T. Heycock and Mr. F. H. Neville showed some experiments on the superficial color changes of a silver-zinc alloy. In the meeting room Professor W. E. Ayrton gave an experimental demonstration of some electric and mechanical analogues, and Professor J. B. Farmer showed lantern slides from microphotographs illustrating nuclear divisions in animal and vegetable cells.

UNIVERSITY AND EDUCATIONAL NEWS.

THE United States Supreme Court has dismissed the appeal in the Merritt suit, and the bequests left by Mrs. Catherine M. Garcelon in 1891 will now be paid. Bowdoin College, Brunswick, Me., will receive $400,000 and a hospital will be established at Oakland, Cal., at a cost of $600,000.

AN attempt is being made to break the will of the late William Lampson, who bequeathed nearly a million dollars to Yale University. It is to be hoped that the aged aunt and forty-two cousins of Mr. Lampson may be no more successful than were the contestants of the will of Mrs. Garcelon! It seems unfortunate that it is possible for distant relatives to delay and often even to annul public bequests, and that American courts should be so much more disposed than those of European countries to admit objections to the validity of wills.

THE Teachers' College of New York receives $10,000 by the will of the late Mrs. Julia Augusta Kemp, and is also made her residuary legatee. It is now announced that Mr. Joseph Milbank was the donor who, in March, 1896, gave $250,000 for enlarging the Teachers' College. The new building, now nearly completed, will be called Milbank Memorial Hall.

THE Building Committee of the University of Montana, at Missoula, has decided to erect a main building at a cost of $47,500 and a science hall at a cost of $12,500.

APPLICATIONS for the Savilian professorship of geometry at Oxford University, vacant by the death of Professor Sylvester, must be received not later than June 12th. The salary is about $4,500 and the duties are confined to the delivery of forty-two lectures.

DR. E. G. JANEWAY, President of the New York Academy of Medicine, has been elected professor of medicine, and Dr. S. F. Dennis, professor of surgery in the faculty of the New York University Bellevue Hospital Medical College.

IT is stated in the daily papers that Dr. Antoneo Crocichia has been elected to the chair of biology in the Catholic University, Washington.

DR. J. S. ELY, professor in the Woman's Medical College, New York, has been elected professor of the theory and practice of medicine in the Medical School of Yale University.

WE learn from the *Botanical Gazette* that Dr. E. B. Copeland has been appointed assistant professor of botany in the University of Indiana in place of Dr. Geo. J. Peirce, who resigned to accept a similar position, in charge of plant-physiology in the Leland Standford Junior University.

DR. BECK, of the University of Lemberg, has been promoted to a full professorship of physiology, and Dr. Konrad Zeisig has been made second professor of physics in the Polytechnic Institute of Darmstadt. Dr. Deichmüller, observer in the observatory at Bonn, has been appointed associate professor. Dr. Ludwig Heim, of Würzburg, has been called to an associate professorship of bacteriology in the University of Erlangen. Dr. Hillebrand has qualified as docent in astronomy in the University at Vienna.

DISCUSSION AND CORRESPONDENCE.

THE DISCRIMINATION OF SPECIES AND SUBSPECIES.

DR. MERRIAM'S paper in SCIENCE for May 14 (N. S., Vol. V., No. 124, pp. 753–758), entitled 'Suggestions for a New Method of Discriminating between Species and Subspecies,' opens up a question of immense interest and far-reaching importance, respecting which there is room for two widely divergent opinions, both susceptible of support by arguments of considerable weight. Dr. Merriam cites the purely conventional and arbitrary rule adopted in the A. O. U. 'Code of Nomenclature' for deciding the status of closely related forms with reference to whether they are to be ranked as species or subspecies, and calls attention to the well-known inconsistencies sometimes resulting from its use. The failure of the rule to yield always satisfactory results is not due to the principle involved, but to the imperfection of our knowledge respecting what closely related forms intergrade and what do not. Consequently, it is urged, a stable nomenclature for such forms cannot be attained under this rule till we have a complete knowledge of the relations of such forms; in the meantime their status will be unstable, and their nomenclature, in this respect, subject to change as our knowledge of them increases.

The first part of the rule as summarized by Dr. Merriam (l. c., p. 753)—to wit: "Forms known to intergrade, no matter how different, must be treated as subspecies and bear trinomial names"—presents no difficulty of application and can be carried into effect without imperiling stability of nomenclature. The second part —namely, "forms not known to intergrade, no matter how closely related [or, rather, how closely they resemble each other], must be treated as full species and bear binomial names" —is difficult to apply always consistently. As Dr. Merriam says, "only in a small percentage of cases does an author have at his command a sufficiently large series of specimens, from a sufficient number of well-selected localities, to enable him to say positively that related forms do or do not intergrade;" and that consequently "authors usually exercise their individual judgment as to the *probable* existence or non-existence of intergradation," based, of course, on the nature of the differences, the geographical relationship of the forms, and on general grounds —on what is known to happen in other similar cases. Hence, naturally, some degree of inconsistency results in the use of trinomials, they being frequently employed where conclusive evidence of intergradation is lacking, though strongly indicated by the circumstances of the case. When later information shows that the true relationship of the forms in question has not been correctly indicated, their status must be changed, either from that of a species to a subspecies, or the reverse, as the case may require. But this, while undesirable, is not a serious change, since the 'special' name (specific or subspecific) is necessarily retained—a change far less important than the substitution of one name for another, as not infrequently becomes imperative from other causes.

The real question, then, is whether we can

not well afford to wait for any necessary rectifications of this sort rather than to adopt any alternative thus far suggested. I am heartily in sympathy with any effort to improve the present somewhat unsatisfactory method, and am glad Dr. Merriam has raised this important question for discussion, respecting which the comparison of opinions of experts in this line cannot fail to be interesting and profitable. I am also glad that Mr. Roosevelt has presented 'A Layman's Views on Scientific Nomenclature' (SCIENCE, N. S, Vol. V., No. 122, April 30, 1897), believing that such discussions have value in rendering clear the 'reason of things' under our modern phase of systematic zoölogy, as it has drawn forth Dr. Merriam's admirable exposition of the 'other side.'

I cannot, however, quite subscribe to Dr. Merriam's proposed remedy for this 'incurable inconsistency' and these 'inevitable changes' contingent on increase of knowledge. It is proposed that we base our recognition of species and subspecies on 'the degree of difference between related forms,' principally on the ground that "a knowledge of this is infinitely more important than a knowledge of whether or not the intermediate links connecting such forms happen to be living or extinct." In other words, it would be more useful "if the terms species and subspecies were so used as to indicate degree of difference, rather than the author's opinion as to the existence or non-existence of intergrades." On this point there is obviously room for difference of opinion. This phase of the subject, however, may be waived as aside from the main point, which I take to be the feasibility or non-feasibility of adopting the 'degree of difference' standard for species and subspecies. Yet I would like to add, in passing, that to me it is of far greater interest to know that the connecting links between quite unlike forms still exist, and that we have thus positive evidence of their genetic relationships, than to know that these forms, in their extreme phases, have become so far differentiated as to present differences as great as ordinarily characterize closely related species.

The real difficulty with the degree of difference principle is its elasticity; it enlarges to the widest possible extent the personal equation element, which is one of the alleged sources of dissatisfaction with our present system. Dr. Merriam's paper, taken as a whole, so far shows the wide influence of 'personal equation' in such matters that little need be added on this point, except by way of further illustration. The diversity of opinion respecting the amount of difference required to distinguish genera and subgenera is notorious; is it likely to be any less in the case of species and subspecies, in case degree of difference is taken as the basis of their recognition? In reply to this, reference may be made to the treatment of North American birds by the authors of the 'British Museum Catalogue of Birds,' on the one hand, and of the 'A. O. U. Check List,' on the other. In the former work some of the most worthless subspecies are given the rank of full species, while, on the other hand, many of the most strongly marked subspecies, and even some species, are wholly ignored, being reduced to synonyms, with often not a word of comment. And this is done not in one group, nor by one author, but in all groups and by each of the half-dozen or more eminent ornithologists who have contributed to this monumental work. This does not foreshadow any 'narrowing of bounds' of the personal equation element, nor give much hope of agreement on any 'degree of difference' standard for the basis of species and subspecies.

As is well known, not only a great deal depends on 'the point of view,' but also on the quantity and character of the material different authors may have before them, in relation to their conclusions on identical questions. The point of view, expertness and amount and kind of material are thus factors in the case, so that, whether we adopt the intergradation test or the degree of difference test, we are not likely to reach unanimity of opinion on such matters for a long time to come.

But there are other points that demand consideration. The advocates of the 'intergradation' test claim that it is based on a philosophic principle, and that the use of a binomial term means one thing and the use of a trinomial term means another and a very different thing.

Binomial names are given only to forms known or supposed to be non-intergrading—to

fully segregated species; trinomial names and forms known or supposed to intergrade, to incipient species or geographical forms, to species still in process of evolution. As said by the present writer some years ago (*Auk*, I., 1884, 201): "It hence follows that the terms species and varieties [or subspecies] are not interchangeable at will, but expressions for certain definite and known facts in nature, grounded on a philosophic principle, to ignore which is not only unscientific, but is to deprive us of a means of precise definition at a point where precision is of high importance."

It thus seems to me better to maintain our theoretically hard-and-fast standard for regulating the status of closely related forms than to adopt so elastic and unphilosophic a basis, and one withal so eminently open to the influence of personal equation, as the 'degree of difference' criterion must inevitably be, and allow time and research to correct the lapses that may occur under our present system.

J. A. ALLEN.

TO THE EDITOR OF SCIENCE: I have been greatly interested in Dr. Merriam's article as to discriminating between species and sub-species. With his main thesis I entirely agree. I think that the word 'species' should express degree of differentiation rather than intergradation. I am not quite at one with Dr. Merriam, however, on the question as to how great the degree of differentiation should be in order to establish specific rank. I understand entirely that in some groups the species may be far more closely related than in others, and I suppose I may as well confess that I have certain conservative instincts which are jarred when an old familiar friend is suddenly cut up into eleven brand new acquaintances. I think he misunderstands my position, however, when he says, "Why should we try to unite different species under common names?" He here assumes, just as if he were a naturalist of eighty years ago, that a 'species' is always something different by its very nature from all other species; whereas the facts are that species, according to his own showing in the beginning of his article, are merely more or less arbitrary divisions established for convenience's sake by ourselves, between one form and its ancestral and related forms.

I believe that with fuller material Dr. Merriam could go on creating new 'species' in groups like the bears, wolves and coyotes until he would himself find that he would have to begin to group them together after the manner of the abhorred 'lumpers.' His tendency to discover a new species is shown by the allusion in the last part of his article to the 'unknown form of wapiti,' which has been exterminated from the Allegheny country. The wapiti was formerly found in the Allegheny regions; there it was beyond a doubt essentially the same animal that is now found in the Rockies. Probably it agreed more closely with the wapiti of Minnesota, which still here and there survives, than the latter does with those of Oregon. It may have been slightly different, just as very possibly a minute study of wapiti from the far south, the far north, the dry plains, the high mountains and the wet Pacific forests might show that there were a number of what Dr. Merriam would call 'species' of wapiti. If this showing were made, the fact would be very interesting and important; but I think it would be merely cumbrous to lumber up our zoological works by giving names to all as 'new species.' It is not the minor differences among wapiti, but their essential likenesses, that is important.

So with the wolves. Dr. Merriam has shown that there are different forms of wolf and coyote in many different parts of the country. When he gets a fuller collection I am quite sure he will find a still larger number of differences and he can add to the already extensive assortment of new species. Now, as I have said before, it is a very important and useful work to show that these differences exist, but I think it is only a darkening of wisdom to insist upon treating them all as a new species. Among ordinary American bipeds, the Kentuckian, the New Englander of the sea coast, the Oregonian, the Arizonian, all have characteristics which separate them quite as markedly from one another as some of Dr. Merriam's bears and coyotes are separated; and I should just as soon think of establishing a species in the one case as in the other.

Some of the big wolves and some of the coyotes which Dr. Merriam describes may be entitled to specific rank, but, if he bases separate species upon characters no more important than those he sometimes employs, I firmly believe that he will find that with every new locality which his collectors visit he will get new 'species,' until he has a snarl of forty or fifty for North America alone; and when we have reached such a point we had much better rearrange our terminology, if we intend to keep the binomial system at all, and treat as a genus what we have been used to consider as a species. It would be more convenient and less cumbersome, and it would be no more misleading.

Dr. Merriam states that the coyotes do not essentially resemble each other, or essentially differ from the wolves. It seems to me, however, that he does, himself, admit their essential difference from the wolves by the fact that he treats them all together even when he splits them up into three supra-specific groups and eight to eleven species. He goes on to say that there is an enormous gap between the large northern coyote and the small southern coyote of the Rio Grande, and another great gap between the big gray wolf of the north and the big red wolf of the south, while the northern coyote and the southern wolf approach one another. Now I happen to have hunted over the habitats of the four animals in question. I have shot and poisoned them and hunted them with dogs and noticed their ways of life. In each case the animal decreases greatly in size, according to its habitat, so that in each case we have a pair of wolves, one big and one small, which, as they go south, keep relatively as far apart as ever, the one from the other. At any part of their habitat they remain entirely distinct; but as they grow smaller toward the south a point is, of course, reached when the southern representative of the big wolf begins to approach the northern representative of the small wolf. In voice and habits the differences remain the same. As they grow smaller they, of course, grow less formidable. The northern wolf will hamstring a horse, the southern carry off a sheep; the northern coyote will tackle a sheep, when the southern will only rob a hen-roost. In each place the two animals have two different voices, and, as far as I could tell, the voices were not much changed from north to south. Now, it seems to me that in using a term of convenience, which is all that the term 'species' is, it is more convenient and essentially more true to speak of this pair of varying animals as wolf and coyote rather than by a score of different names which serve to indicate a score of different sets of rather minute characteristics.

Once again let me point out that I have no quarrel with Dr. Merriam's facts, but only with the names by which he thinks these facts can best be expressed and emphasized. Wolves and coyotes, grizzly bears and black bears, split up into all kinds of forms, and I well know how difficult it will be and how much time and study will be needed, to group all these various forms naturally and properly into two or three more species. Only a man of Dr. Merriam's remarkable knowledge and attainments and ability can ever make such groupings. But I think he will do his work, if not in better shape, at least in a manner which will make it more readily understood by outsiders, if he proceeds on the theory that he is going to try to establish different species only when there are real fundamental differences, instead of cumbering up the books with hundreds of specific titles which will always be meaningless to any but a limited number of technical experts, and which, even to them, will often serve chiefly to obscure the relationships of the different animals by over-emphasis on minute points of variation. It is not a good thing to let the houses obscure the city.

THEODORE ROOSEVELT.

WASHINGTON, D. C.

GLACIAL MAN IN OHIO.

I HAVE read 'Human Relics in the Drift of Ohio' and Dr. Brinton's criticism of the same in SCIENCE of February 12th.

The gist of Professor Claypole's paper is based upon the discovery of a polished stone axe, made by a well-digger in Ohio ten years before.

Not with especial reference to this discovery, but *apropos* of the danger of accepting any statement at second hand even from the most veracious person (for we are all liable to error), I would like to cite two personal experiences

which occurred during my mound-work in Florida.

At one time I had almost completed the slicing-down of a large mound in which no object in any way connected with Europeans had been found.

While my back happend to be turned I heard a cry and went to the colored digger from whom it came and who, I found, held in his hand an iron spike—a sure sign of European contact.

"From where did this come?" I asked.

The digger did not seem to comprehend my question and, as time pressed, I asked a leading question, which no investigator should do. I inquired again, "Did it come from the base?"

"Yes, sah, from de base," replied the digger.

I was somewhat nonplussed, for I never had (and never have) dug down a mound of any size where artifacts of white origin were present other than superficially.

Suddenly an idea struck me. "Where is the base?" I asked.

"Why, at de top, sah," replied the digger.

Once in conversation with a very intelligent man, the leading citizen of a town on the Ocklawaha river, I was somewhat startled at the information that the speaker had in his house a grooved stone axe found on his place.

I pointed out that no report had yet appeared as to the discovery of a grooved axe in Florida. The speaker was positive. He *knew* he was right. I asked him, as a favor, to consult with his family at dinner as to the matter and to let me know later on.

In the afternoon he called on me and stated that the grooved stone axe was a present from a friend in Alabama and that the implement found on his place had no groove.

CLARENCE B. MOORE.

THE SMITHSONIAN INSTITUTION AND A NATIONAL UNIVERSITY.*

SINCE our conversation about the organization and purpose of the Smithsonian Institution I have been thinking much about the matter. Certain things seem clear. The Institution is at the National Capital; whatever it does must represent the best there is in the country. The plan of its foundation and the purposes of the founder were broad; it ought, if it can be found in any way practicable, to represent more than one, two or three branches of scientific knowledge. The problem is how, with the limited fund at disposal, to combine the two things, supreme excellence and wide scope.

I think I can conceive of a plan. Whether it is practical or not will be for others who are nearer at hand and better acquainted with the details to determine.

Since the Institution began its work the conditions of scientific work in this country have radically changed. There were then but few recognized departments of scientific endeavor; now the differentiation of the sciences has advanced into great multiplicity. Then a single man was able to cover a large field and there were Humboldts in the land; now a man may not venture to call himself a chemist, but defines his specialty as Physical Chemistry, Agricultural Chemistry, Chemistry of Gases, Inorganic or Organic Chemistry, etc. Then there were no universities in the present sense. There were no institutions where any large number of different scientific fields were occupied by advanced investigators. There were colleges which taught, not universities which learned.

It is now no longer possible for the Smithsonian Institution to compete, even in a single department, with the larger universities. According to its present organization it has, and can have, but one or two men for one or two departments. There are now a half-dozen universities that can and do employ a considerable force of men for each of a large list of scientific departments, each of which is equipped with laboratories, apparatus and collections. A man who permanently establishes himself in residence at Washington at the Institution cuts himself off from many associations he would find at a university. He loses the opportunity of laboratories and carefully assembled collections of the literature of his subject. He loses the stimulus of teaching and of working with investigators and of directing investigations. The Smithsonian Institution is not a university and

* A letter addressed by Professor Benjamin Ide Wheeler, of Cornell University, to the Hon. Gardiner G. Hubbard, Washington, and published here with the permission of Professor Wheeler and Mr. Hubbard.

cannot become one. It would be vain for it to attempt to duplicate the outfit of a modern university.

Its mission and its opportunity is *to utilize the existing mechanism* of the scientific departments *of all the different American universities.* In some sense also it may coordinate them and unite them.

At present, at least, there seems to be no place for a National University at Washington, certainly not in the sense that another university should be added to those that now exist in the country, like them or only a little better than any one of them.

By coordinating and uniting what now exists, the Smithsonian Institution may well furnish, at least in reference to the aggressive scientific work of the country, the beginnings of such a National University as is really needed.

I think it would be practically possible to make a beginning in this direction in the following way:

1. Establish and recognize a certain number of scientific departments, say fifteen at the start. Let all these be recognized as constitutive parts of the Institution.

2. Appoint, by careful selection, a committee of three men, the most eminent in their lines to be found in the country, to represent each department. (This the least essential part of my suggestions.)

3. Make one man the chairman and assign him a salary appropriate to the work expected of him.

4. Let these men, the chairmen, remain, if so already, professors in active service in the universities where they belong. Secure for them, from these universities, the right to spend a certain portion of each year at Washington, say six to ten weeks, in some cases perhaps much less. Let their salaries be additional to their university salaries, in case their universities consent to allow them the time as a vacation; otherwise make these salaries a portion of their university salaries. The latter course may be necessary in cases where a man is regularly absent from his university work as much as one-third of the university year. This plan would be of advantage to the men, because of the opportunity and the prestige; to their universities, because of the advantage it would be to the men themselves; to the Institution, because of the work they would do, better and larger than the Institution could secure from men whose entire services it would be able to obtain.

5. Each man put in charge of a department would do such work in upbuilding and helping his department as he, in consultation with his committee, found practical and advantageous to do. Some could devote themselves to the collections; some would lecture or arrange courses of lectures; some would organize, stimulate and assist work in their departments going on in different parts of the country. Some would use the opportunity to interest the National Government in enterprise akin to their work, and to influence the conduct of those already undertaken.

This is a suggestion of a way to begin what would, I believe, develop into something of great use to the country, and would furnish a true and fit utilization of the existence of the Institution in its present habitat and with its present conditions.

Sincerely yours,

BENJ. IDE WHEELER.

SCIENTIFIC LITERATURE.

Outlines of Psychology. By WILHELM WUNDT. Translated by CHARLES HUBBARD JUDD. Leipzig, Wilhelm Engelmann. 1897. 8vo, pp. 342.

An Outline of Psychology. By EDWARD BRADFORD TITCHENER. New York, The Macmillan Company. 1897. 8vo, pp. 352.

The fundamental aim and interest in both these treatises is the instructional one; while by no means limited to this phase of utility, the volumes are primary text-books and may be judged by their fitness to increase the efficiency and attractiveness of the teaching of psychology. Such a verdict would be much easier to reach were there a more complete agreement as to the content or the methods, the order of exposition or the perspective of importance, of the several trends of investigation that lend diversity as well as frequent confusion to psychological discussions. But the 'psychologies' are unmistakably converging both in matter and manner, and it is becoming less

hazardous to predict the general nature of the contents of a volume upon the basis of the occurrence of the word 'Psychology' on its title-page.

The two works are, moreover, quite similar in size and scope; they are equally methodical and systematic; they reflect in each case the well defined convictions of the author, and the author in each case is an experimentalist thoroughly in touch with a rigid scientific conception of the methods and problems of mental investigation. A still further note of agreement is to be found in the strong insistence upon the specifically psychological aspect of the questions considered; physiological considerations are reduced to a minimum, and philosophical speculations are, in almost all instances, avoided, except when they seem to be required to furnish a basis for psychological interpretations. The reader never loses sight of the fact that the subject under discussion, whether sensation or perception, whether attention or movement, whether the sentiment or reasoning, is always treated as a strictly and exclusively psychological problem, as a description, classification, interpretation, analysis and explanation of a mental process or product. This trait gives a very impressive sense of consistency, order and completeness to the expositions. It arouses the agreeable feeling that, in spite of all the discussions and controversies, in spite of all schools and attitudes, there really is a science of psychology; that psychology is not merely a shapeless region as yet unoccupied by the adjoining domains of the sciences and upon which these sciences may encroach at pleasure, but a definitely organized country with distinctly recognizable boundary lines. Of course, this agreeable feeling is apt to be disturbed when we turn to other phases of modern psychological literature; but it is a welcome resource, and particularly so for the student to have such an exposition to fall back upon. This end is gained at a considerable sacrifice of suggestiveness and attractiveness; but it is obviously the deliberate plan of both authors, and in both cases the plan is well carried out.

As between the two—for the odium of comparison does not obtain, when the two things compared are really comparable—the preference of American teachers and readers will be for Professor Titchener's work. The American student seems to require not merely a road-map and sign-posts, but a personal guide, or at least an illustrated and attractive guide-book; he needs not merely an opportunity to go right, but an incentive to keep going, as well as frequent corrections of tendencies to pursue misleading and aimless side paths. Such direction he is much more likely to find in Professor Titchener's pages than in those of Professor Wundt; he is not likely in either case, however, to find as attractive a path as he had hoped for, and will find many regions through which the path is difficult to follow and by no means easy when found. Psychology has a very unfortunate reputation in the minds of the college student, as a study peculiarly difficult, to be pursued by methods unusual and intricate. A perfect text-book would minimize the grounds for such a reputation by constantly assimilating the unfamiliar by the aid of the familiar. Many a student who enters upon the study of that section of psychologic optics dealing with the perceptive powers of the outlying parts of the retina fails to obtain the proper results, because of his difficulty in fixing his gaze at one point and his attention at another, or because he allows his eyes to roam about when they should be rigidly fixed. The usual and useful method of seeing is to focus the gaze and the attention together and to allow the eyes freely to move about and explore the field of view, but for the study of the analysis of space perception it is necessary to overcome this tendency and to acquire an unusual mode of vision. Such, in some measure, is the relation between the daily mental experience by means of which every one acquires a real acquaintance with mental processes and results and the technical study of psychology. But the contrast between these two attitudes should not be allowed to interfere with the easy and attractive transition from one to the other, nor with the correct appreciation of the function and place of each. The student should not be tempted to observe the world by indirect vision, but he should be led to acquire the tendency to observe unapparent details and to gain an insight into the significance of what is common and obvious. It is

just here that a strictly systematic, rigidly methodical and abstractly analytical text-book of psychology will fail as a pedagogical instrument. If it be a sound psychological doctrine that assimilation demands attention and attention is fed by interest, then the creation and maintenance of an interest is an essential of every text-book, as it is of every teacher. It may be well urged that for this purpose an ounce of teacher is worth a pound of text-book, but even the teacher is better equipped to inspire if he preaches from an inspiring text.

It remains to indicate very briefly the distinctive features and contents of the two books. Following an introductory chapter upon the nature of psychological problems, Professor Titchener devotes three chapters to the simplest element of consciousness, sensation, treating it in its qualitative and quantitative aspects and dwelling as well upon the methods of studying sensation. The affective side of mental life is considered in three somewhat widely separated chapters, first as simple affection, then as feeling and emotion, and again as sentiment. Similarly the will, the active side of psychic phenomena, is considered, first as conation and attention, then as voluntary movement, and (in connection with other processes) in the reaction synthesis. The elaborations of sensation, the complexes to which they lead, are treated under the usual headings—perception, ideas, recognition, memory, imagination, self-consciousness and reasoning. It is thus apparent that the method and order of exposition begins with the simplest elements of consciousness—the last results of analysis—and then considers in turn the compounds and elaborations into which these elements are built up.

Professor Wundt's scheme involves a more elaborate systematization. He devotes considerable space to the general methods and problems of psychology by way of introduction, and then discusses the processes of mental life; first, as psychical elements (sensation and simple feelings); second, as psychical compounds (ideas of intensity, space, time, location, etc., as also composite feelings, emotions and volitional processes); third, as interconnection of psychical compounds (consciousness, attention, association, memory, apperception, etc.); fourth, as psychical developments (the mind of animals, of the child, of society and the race); and finally concludes by the discussion, under the title 'Psychical Causalty and its Laws,' of a problem which belongs quite as much to philosophy as to psychology.

As a translation inherently difficult the result is creditable; but it hardly reaches the ideal criterion of the art that conceals art, for the book seems un-English on every page. The type, the binding, the manner of construction, are all unmistakably German and, together with the foreign terminology and mode of presentation, detract considerably from the possible attractiveness of the volume to the English reader.

Viewed as independent contributions to psychology, both works present a considerable measure of originality. The student of Wundt will naturally turn to his other writings for a more complete exposition of his interpretations of psychological problems, but will find in the 'Outlines' (for instance, in the discussion of psychological methods and classification) many pages that form an essential contribution to his published work. Similarly in Professor Titchener's volume one recognizes many a doctrine and exposition that reflects the outcome of special and original investigation, as well as a position resulting from recent research. Viewed both as text-books and as contributions to psychological discussion, the volumes may unhesitatingly be pronounced welcome and interesting; the further proof of their utility must await the test of time and use.

JOSEPH JASTROW.

UNIVERSITY OF WISCONSIN.

GEOLOGIC ATLAS OF THE UNITED STATES. *Folio 23, Nomini, Maryland-Virginia, 1896.*

This folio consists of four pages of text signed by H. N. Darton, geologist, a topographic map of the district, a map showing the areal geology, and a map showing the distribution of underground waters and artesian wells. The scale of these maps is 1:125,000.

The area represented in this folio is about 938 square miles, which lies partly in Virginia and partly in Maryland. In Virginia it comprises nearly all of Westmoreland county, with parts of Essex, Northumberland and Richmond,

and in Maryland it includes portions of St. Mary, Charles and Calvert counties. It lies entirely within the Costal Plain area. The Potomac river extends northwest and southeast across the middle of the area; the Patuxent river crosses its northeastern corner, and the Rappahannock river crosses its southwestern corner. To the extreme northeastward it extends to the shore of Chesapeake Bay. These waters are all tidal estuaries. Along the river valleys there are wide, low terraces, capped by the Columbia formation, of Pleistocene age. The intervening areas are plateau remnants, capped by Lafayette deposits, of supposed Pliocene age. The underlying formations are the Chesapeake and Pamunkey, the latter extending from the westward only a few miles into the area, along the north side of the Potomac river.

The Pamunkey formation, of which only the uppermost beds are exposed, consists in greater part of glauconitic marls of Eocene age. It is overlain unconformably by the Chesapeake formation, which is characterized by fine sands, marls and clays, portions of which consist largely of diatomaceous remains. The formation is very fossiliferous at some localities. Its age is Miocene. The greatest thickness which it presents in the Nomini area is about 270 feet, but it continues to thicken gradually to the eastward.

The Lafayette formation, which ranges from 25 to 40 feet in thickness, consists of sandy loams of orange, brown and buff tints, often variegated, containing irregularly disposed bands and sprinklings of small quartzite pebbles and coarse sands. The pebbles and larger sand grains are orange-tinted, mainly by superficial staining. The plateau surface, capped by this formation and deeply incised and dissected by the larger drainage depressions, inclines gently southeastward at an altitude ranging from about 190 feet along the northern and western border of the area to about 90 feet along its eastern border. Its greatest altitude is 200 feet in a portion of Nomini cliffs. It has also in most cases a slight slope into each of the river valleys.

The Columbia formation is a deposit of loam merging downward into coarser materials containing beds of quartzite, gravel and boulders. Its thickness averages about 20 feet. Its surface extends from altitudes of 5 to 60 feet above tide level.

The principal economic features are underground waters, which on the lower lands furnish flows for artesian wells. Three water-bearing horizons are known—one at the base of the Pamunkey formation, another 100 feet higher in the Pamunkey formation, and a third in the lower sandy members of the Chesapeake formation. They all dip to the eastward at a very moderate rate. There are many artesian wells which obtain water supplies from 160 to 305 feet. On the artesian well sheet of the folio distinctive underground contours are given to show the depths below tide level to all of the water-bearing horizons.

Other economic resources of the area are marls in the Pamunkey and Chesapeake formations, diatomaceous deposits in the Chesapeake formation which are often sufficiently pure for commercial use, brick clays, potters' clays, sand and gravel.

Folio 26, Pocahontas, Virginia-West Virginia, 1896.

This folio, by Marius R. Campbell, consists of five pages of text, a topographic sheet (scale 1: 125,000), a sheet of areal geology, one of economic geology, another of structure sections, and, finally, a sheet giving a generalized columnar section of the district.

The territory mapped and described in this folio embraces an area of 950 square miles, the southern portion of which is in Virginia and the northern portion in West Virginia. It is located west of New (Kanawha) river, at the place where the State line leaves East River Mountain, the last of the valley ridges toward the northwest, and follows the irregular crests of the ridges within the coal field. The southern portion of this territory is within the limits of the Appalachian valley, and its surface is marked by linear mountains and narrow valleys, which are the characteristic forms of this central division of the Appalachian province. The northern portion is within the Cumberland plateau region, and its surface is that of a tableland deeply dissected, so that it now presents a confused mass of irregular ridges and hills,

only the summits of which reach the original level of the plateau.

The geologic structure of this region varies as the topography varies. In the northern portion the rocks are nearly horizontal, their northwestward slope being rarely more than 200 feet per mile, whereas in the southern portion the rocks have been highly compressed in a horizontal direction, forming huge folds, which in many places have broken, allowing one portion of the fold to slip over the other. It is this tilted condition of the strata which gives rise to the regular topographic forms of the Appalachian valley. The attitude of the rocks is shown on the structure-section sheet by four sections which cross various portions of the territory.

The geologic history of this region is recorded in the rocks, which tell of prevailing marine conditions from early Cambrian to late Carboniferous time. There were deposited during that time sediments to the extent of 17,000 or 18,000 feet in thickness, which have since been hardened into limestone, shale and sandstone. Of this great mass the limestones form about 6,700 feet; the shales, 9,500 feet, and the sandstones, about 1,400. On lithologic grounds these have been divided into twenty-three separate and distinct formations, which are shown on the general geologic map by various colors and patterns.

There is little variety in the mineral resources of this region. Coal, iron ore and marble constitute about all of the mineral wealth of the territory. A limited area of coarse gray marble occurs along the northern front of Big Walker Mountain, but no development has been undertaken.

Iron ore occurs in two formations of the Upper Silurian rocks. It is of good quality, and probably in sufficient quantity to be of commercial importance, but its inaccessibility has prevented development.

Coal is by far the most important mineral resource of this region. The territory represented by this sheet embraces almost the entire Flat Top or Pocahontas coal field at present developed. All operations are confined to the great No. III. or Pocahontas seam of coal, which is semi-bituminous and ranges in thickness from 4 to 10 feet. It is exposed along the valley of Bluestone river from Pocahontas to the edge of the territory, along Tug Fork, in the valley of Elkhorn creek, from Coaldale to Kimball, near the edge of the area and at several places on the head streams of Guyandotte river. Mining is restricted to the Bluestone region and the valley of Elkhorn creek. In these two areas there are at present in operation thirty-seven distinct mines, which in 1894 produced 3,096,867 long tons of coal.

Folio 28, Piedmont, West Virginia-Maryland, 1896.

This folio consists of six pages of text, signed by N. H. Darton and Joseph A. Taff, geologists, and closing with a series of vertical sections showing the positions and thicknesses of the coal beds; a topographic map; a sheet showing the areal geology of the district; another showing the economic geology; a third exhibiting structure sections, and a fourth containing a columnar section and a key to the synonymy of the various formation names. The maps are on a scale of 1:125,000.

The area represented is about 925 square miles. In Maryland it comprises the southern portion of Garrett county and a small area in the southwestern corner of Allegany county. In West Virginia it includes nearly all of Grant county, the western portions of Hardy and Mineral counties, the northeastern portion of Tucker county, and a narrow area of Preston county, adjacent to the Maryland boundary line. Its southeastern corner is in a region of Appalachian ridges, and it extends northwestward over the Allegheny Mountains and the upper Potomac coal basin to the headwaters of the Youghiogheny river, a branch of the Monongahela river.

The geologic formations comprise members ranging from the sandstones in the middle of the Silurian to the upper Coal Measures of the Carboniferous. In the southeastern portion of the area there are two sharp anticlinal uplifts which bring up the Silurian rocks in two prominent mountains, New Creek Mountain and Patterson Creek Mountain. To the westward lies the coal basin, which extends from the Allegheny front to the Backbone Mountain. Along its center is cut the deep gorge of the north branch of the Potomac river. The basin is a relatively shallow

one, but it contains about 3,000 feet of Carboniferous deposits. To the westward is the anticlinal region of Devonian rocks which underlie the characteristic glade country about Oakland, Mountain Lake Park and Deer Park. West of Oakland is another synclinal basin, containing about 2,500 feet of Carboniferous beds.

The geologic classification does not differ materially from that outlined by W. B. Rogers and others, but geographic names have been applied to all of the formations. The lowest members are a series of sandstones and quartzites, which have been referred to as No. IV. and 'Medina.' This series has been subdivided into the Juniata formation, consisting of brownish-red sandstones and shales; the Tuscarora quartzite, and the Cacapon sandstones, consisting of thin-bedded red sandstones. Next there is the representative Clinton formation, which has been designated the Rockwood formation, as in other folios; the Lewistown limestones, including representatives of the Helderberg and associated limestones, and the Monterey sandstones, Romney shales, Jennings formation and Hampshire formation, representing the Devonian deposits. As the last three formations are not sharply separated from one another, the patterns by which they are represented on the map are merged in a narrow zone along their boundaries. The Carboniferous period is represented by the Pocono sandstone; the Greenbrier limestone; the Canaan formation, which in a general way is a representative of the Mauch Chunk shales; the Blackwater formation, which represents the Pottsville conglomerate in greater or less part; the Savage formation and Bayard formation, which are the Lower Coal Measures; the Fairfax formation, or Lower Barren Measures, and the Elk Garden formation, a part of the Upper Coal Measures.

The principal coal beds are in the Savage formation, containing the 'six foot' or Davis coal bed; the Bayard formation, containing the coal bed known as the 'four-foot,' or 'three-foot,' or 'Bayard,' or 'Thomas' coal, and the Elk Garden formation, containing the 'fourteen-foot' coal bed.

On the economic sheet of this folio the coal-bearing formations are strongly emphasized, and underground contours are introduced to show the lay of the 'six-foot' coal bed in the Savage formation for each 100 feet. Other economic resources of the area are red hematite iron ores in thin beds in Rockwood shales and limestones at several horizons, of which the lower member in the Lewistown is locally available for cement.

Folio 29, Nevada City Special, California, 1896.

This folio, by Waldemar Lindgren, consists of seven pages of text, three special topographic maps (scale 1:14,400)—the Grass Valley, Nevada City and Banner Hill—three corresponding maps showing the economic geology, and three others giving structure sections.

These maps, on a scale of about four inches to the mile, have been prepared to illustrate the detailed structure of the gold-mining regions in the vicinity of Nevada City and Grass Valley. Each of them comprises an area three miles wide by four miles long, the total area being nearly thirty-six square miles. The Nevada City and Grass Valley areas fall within the boundaries of the Smartsville atlas sheet, while the larger part of the Banner Hill area falls within those of the Colfax atlas sheet. The relief is that common to the middle foothill region of the Sierra Nevada—that is, the surface is a very irregular and undulating plateau, deeply trenched by the canyons of the recent river systems.

Sedimentary rocks, chiefly referred to the Calaveras formation, occupy small, usually narrow and long areas imbedded in the predominating igneous masses. Granodiorite occupies a large part of the Nevada City and Banner Hill districts, while a small massif of the same rock is found in the Grass Valley district. Large areas of diabase, porphyrite and brecciated forms of these rocks surround and separate the granodiorite areas. In the southwestern part of the Nevada City district and the northeastern part of the Grass Valley a large and complicated massif is found, consisting in part of diorite, in part of gabbro, pyroxenite and serpentine.

The slates of the Calaveras formation are the oldest rocks. Next younger are the diorities, gabbros and serpentines. Still later are the diabases and porphyrites, and the intrusion of granodiorite closes the succession of igneous rocks.

The bed-rock series is, as usual, in places covered by several hundred feet of Neocene gravels and rhyolitic and andesitic tuffs, the gently sloping top of the andesitic ridges forming a principal feature of the landscape.

The Neocene auriferous gravels have been extensively worked in the Nevada City and Banner Hill districts, both by the drifting and the hydraulic processes, and considerable ground still remains which probably can be profitably worked. The gold-quartz veins are numerous and belong to several distinct systems. They are found in any of the formations represented on the sheet, and generally cross the contacts without change. In the Banner Hill district the veins are narrow but rich, and have a general east-west direction and a northerly or southerly dip. In the Nevada City district the quartz veins have a general north-south direction and an easterly dip of of about 45°. Large dislocations producing over-thrust faults have occurred along several of the veins. In the Grass Valley district there is one system with a west-northwest direction and a steep northerly or southerly dip. On this system the celebrated Idaho mine is located. Most of the veins in the central and southern part of the district have a northerly direction and a flat easterly or westerly dip. The veins are often accompanied by strongly developed sheeting of the country rock.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE June number begins with an article by Theo. Holm, the fourth in a series of studies on the Cyperaceæ. This contains a full morphological and anatomical study of the species *Dulichium*, and is illustrated by a page of figures. J. C. Branner discusses the subject of bacteria in relation to the decomposition of rocks. The literature of the subject is reviewed and references given to various authors who have believed that the bacteria played an important part in this direction. The author decides, however, that it is highly improbable that any considerable amount of rock decomposition is due to this cause. J. H. Pratt and H. W. Foote describe a new mineral species from the Corundum mine, of Buck Creek, Clay county, North Carolina, to which they have given the name *wellsite*, after Professor H. L. Wells, of New Haven. The mineral belongs to the zeolites and is a silicate of aluminum, barium, strontium and calcium, crystallizing in the monoclinic system. It is particularly interesting since it forms another member of the Phillipsite group to which the species *Phillipsite*, *Harmotome* and *Stilbite* belong.

Howard D. Day discusses the magnetic increment of rigidity of wires in strong magnetic fields. The special subject discussed is "the increase of resistance to torque produced by the magnetization of twisted wires of various diameters, when the magnetic field increases to many times the amount needed to bring out the ordinary magnetic saturation. The object of the research was to make a clear comparison between the phenomenon of magnetization or magnetic intensity, on the one hand, and the phenomena of magnetic rigidity on the other; to show that the two are quite distinct in character—that the former practically subsides in relatively weak fields, whereas the latter are not as fully complete even in the highest fields applied." The apparatus employed is described and figured, and the results presented in a series of curves. It is seen that "as the fields become stronger the increment of rigidity varies more and more regularly with the twist, the tendency being that in fields indefinitely large the increment of rigidity would be proportional to the twist applied."

P. F. Schneider describes a geologic fault at Jamesville, near Syracuse, N. Y. The interest of the matter lies largely in the fact that this region has been shown to be characterized by a number of igneous dikes. H. L. Wells and H. W. Foote have two articles on chemical subjects, the first describing certain double halogen salts of cæsium and rubidium, and the second being devoted to the double fluorides of zirconium with lithium, sodium and thallium.

A. St.C. Dunstan, M. E. Rice and C. A. Kraus give the results of some observations made on the broadening of sodium lines by intense magnetic fields. Their results confirm the recently published work of Zeeman. They state that using fields ranging from 0 to 7800

C.G.S. units, they have found that the percentage broadening is directly proportional to the field strength; the absolute amount for sodium in a unit field being 11.46×10^{-6} Angström units.

A. A. Michelson describes some recent experiments, having as their object the discussion of the question as to whether there is a relative motion of the earth and the ether. Light from a certain source was separated into two pencils by a plane-parallel glass plate, and carried by two equal paths back to the observing telescope, where the interference fringes resulting could be observed. The apparatus was set up in a vertical east and west plane, the path being 200 feet long and 50 feet high. In order to eliminate disturbances due to temperature, the path of the light was inclosed in an iron pipe exhausted to within $\frac{1}{100}$ of an atmosphere. It was then found possible to measure the position of the central bright fringe to within something like $\frac{1}{20}$ of a fringe-width. The results of the measurements go to show that if there is any displacement of the fringes it is less than $\frac{1}{20}$ of a fringe. Hence it follows that the earth's influences upon the ether extends to distances comparable to the earth's diameter. The author concludes by saying that with these results before us we are driven to one of the three following extraordinary conclusions:

"1. The earth passes through the ether (or rather allows the ether to pass through its entire mass) without appreciable influence. 2. The length of all bodies is altered (equally?) by their motion through the ether. 3. The earth in its motion drags with it the ether even at distances of many thousand kilometers from its surface."

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON, MEETING OF MAY 12, 1897.

UNDER the title 'Physiography of the West Coast of Peru,' Mr. S. F. Emmons described some of the prominent physiographic features noted by him during a recent and rather hurried journey along the west coast of Peru as far as 16° south latitude, and on a trip on the Oroya railroad from Lima up to the western crest of the Andes and back.

First, he noticed the remarkable difference in rainfall and consequent change in vegetation experienced in the few hours' sail from the mouth of the Guayaquil River, in Ecuador, to the most northern part of Peru. From a region of copious rains and tropical luxuriance of vegetation and often dense forests one passes, over night, to a region where it rains once in seven years, and farther, to where it is absolutely rainless. As far as seen, there is no tree growth on the west slope of the Andes in Peru. In the larger valleys, on the other hand, where irrigation is possible, sugar, cotton, and all varieties of cereals, vegetables and fruits flourish under cultivation. The most evident cause of this condition of things lies in the fact that the wind along the coast blows almost continuously from the south, coming from a colder to a warmer atmosphere, or one whose capacity for carrying moisture is constantly increasing. Hence there is no condensation until the wind currents strike the high mountain slopes. In Ecuador the influence of the highly-charged equatorial currents is felt, and near the mouth of the Guayaquil River the continental watershed pushes westward to within 50 miles of the coast, thus presenting a condensing barrier on the land to the northward-moving currents.

A second striking feature is the enormous extent to which the coast bluffs and the northern slopes of the mountains that approach the sea are covered by white drifting beach sands borne along by the same prevailing south wind. At one point these sands, beautifully ripple-marked, completely mantled the southeast side of a deeply cut mountain valley to an elevation of four to five thausand feet above the sea level, and sand fields were observed inland, along north and south depressions in the elevated plateaux or pampas, 40 to 50 miles from the coast.

Striking evidences of recent elevation and subsidence of the coast regions are most frequent, and where the coast line is formed, as it frequently is, of soft and readily disintegrable Tertiary beds it is seen to be rapidly wearing away under the influence of the long and powerful waves of the Pacific Ocean. Near Pacasmayo a river valley is seen to have been

truncated by this wearing action and at the same time to have been elevated about 50 feet within a comparatively short time. Near Lomas a Tertiary plain 15 to 10 miles wide, and reaching 500 to 600 feet above tide, between the mountains and the sea, has been so recently reclaimed from the sea as to have scattered over its surface not only beach pebbles, but frequent sharks' teeth and occasionally jawbones of whales, from the latter of which the villagers construct the crucifixes they always plant upon some prominent headland. Further inland there is a broad peneplain nearly 6,000 feet above the sea level, fringed by an old sea-beach of rolled pebbles more or less covered by beds of volcanic tuff.

The geological formations along the coast belt, as far as observed, are mostly granites and diorites, in places surrounded by horizontal or slightly crumpled beds from which fossils of probable Miocene and Pliocene age were obtained. To the former apparently belong the very considerable extent of petroleum-bearing beds in northern Peru near Cape Blanco. The main mass of the western crest of the Andes, where observed, consists of closely compressed, infolded limestones, slates and conglomerates, with intrusive andesites and other igneous rocks. These sedimentary beds are thought to be of probable Jurassic age, though no fossils were obtained.

The Telluride mining district, in the San Juan mountains, was described by Mr. C. W. Purington. It is situated in southwest Colorado, on the line of the Rio Grande Southern Railway. It is a mountainous region characterized by precipitous topography. The mountains rise to 14,000 feet from a plateau of 7,000, which bounds the region on the west. The rocks are nearly flat-bedded sedimentaries of Triassic, Jurassic and Cretaceous age, overlain in the eastern part of the quadrangle unconformably by a heavily bedded conglomerate, 200 feet thick, above which lie 2,000 feet of andesitic breccias, in part waterlaid, and still higher 1,000 feet of volcanic flows, andesite and rhyolite. Diorite stocks of large dimensions have cut all the other rocks of the region and are most recent in age. Surface denudation has exposed them to view. The centers of volcanic activity lies to the east of the sheet.

Several well-defined fissure-systems, due to the action of extraneous forces, penetrate the rocks of the region. The systems are characterized by the alternation of widely and narrowly spaced zones of fissures. The zones of narrowly spaced fissures vary from one to ten feet in width, and it is along these that the workable veins are found. Relative movement of the walls of the closely fissured zones, accompanied by trituration of the included rock, developed open space which the ore now occupies. The veins carry gold, mostly free, but in part combined with metallic sulphides, silver mostly in galena and freibergite, less frequently as stephanite, pyrargyrite, polybasite, etc. Beside iron, lead, copper and zinc sulphides, there occur as gangue, predominating quartz, carbonates, barite, fluorite, sericite and other minerals in small amount. Gold and silver veins occur closely associated. Accompanying the veins the wall rocks are altered, and impregnated with iron pyrite, occasionally auriferous. The values vary between wide limits. They must be given in more detail than is possible here. The veins show remarkable continuity in length, one having been profitably worked for a distance of more than two miles.

The ore is of Tertiary age, is of deep-seated origin, and has been deposited from solutions; $20,000,000 is a low estimate for the product of the district. It has steadily increased in importance since 1875, and very rapidly within the last five years. Formerly silver was the principal product; now much the larger output is in gold.

W. F. Morsell.
U. S. Geological Survey.

New York Academy of Sciences—Section of Geology, May 17, 1897.

The first paper of the evening was by Mr. D. H. Newland, entitled 'Occurrence and Origin of the Serpentines near New York.' Mr. Newland spoke of the occurrence of Serpentines in the vicinity of New York and classified them according to origin into two probable divisions; one including those from New Rochelle and Hoboken, possibly derived from metamorphosed igneous rocks, and second, those from the other

localities more probably derived from some form of sedimentary rock.

The second paper of the evening was by Professor J. F. Kemp, entitled 'Notes on Butte, Montana, and its Ore Deposits.' Professor Kemp described the geological position of the copper and silver bearing ore rocks of Butte, and illustrated his talk with a number of lantern slides made from photographs in the region last summer. He spoke particularly of the geological succession exhibited in the relationship of two forms of granite, an earlier basic and a later acitic cut by later rhyolite flows.

The third paper was by Professor Kemp, entitled 'Notes on the Geology of the Trail from Red Rock to and beyond Leesburg, Idaho.' This paper brought forth the first account known of the geology of about 100 miles of the trail mentioned, where the rocks are very varied in character, but mostly early Cambrian quartzites, together with many igneous rocks including Tertiary rhyolites. The ore producing region is found in the valleys where the gravels are washed in some places by hydraulic force and some gold gained therefrom.

The last paper of the evening was by Professor C. A. Doremus, and was illustrated by a series of specimens received from France from M. Moissan, representing certain of the metals and carbides formed by the electric furnace. Some of these were very interesting geologically, because of their peculiar properties; particularly the carbonates of aluminum, calcium and cerium, which latter, when tested with water, produces all the series from marsh gas to the heavier petroleum products. The specimens exhibited are for final placement in the National Museum at Washington, D. C.

This being the last meeting of the Geological Section before the summer vacation, adjournment was made until October.

RICHARD E. DODGE.
Secretary.

THE TORREY BOTANICAL CLUB, MARCH 31, 1897.

THE first paper, by Dr. Albert Schneider, 'The Phenomena on Symbiosis,' and a paper by Leonard Barron on 'Horticulture in Botanical Gardens,' were read by title, owing to unavoidable detentions.

The evening was occupied by a paper by Professor Edward S. Burgess, on '*Aster macrophyllus and its allies*,' illustrated by chart of relationship and by numerous specimens. The speaker sketched the history of the species *Aster macrophyllus*, in which it has been the custom of American botanists to include all large-leaved asters. He showed how diverse these asters are and in what confusion their assignment to a single species results, and indicated the characters according to which they form two groups, each of several species and varieties.

The paper, which will soon appear in print, was discussed by Mr. E. P. Bicknell, who confirmed the distinctions offered, by the results of his observations about New York, and by Dr. Britton, who paid a tribute to the masterly manner in which Dr. Gray has treated the subject of the genus *Aster*, so far as material was then available, and who referred to the special need for extended field-work and further collaboration which this genus has long presented.

APRIL 13.

DR. ALBERT SCHNEIDER presented a paper entitled 'Methods employed in the examination of powdered drugs and their adulterations.'

He described certain microscopic structural features which he had investigated with a view to find characters by which to distinguish the more important drugs, giving details of such characteristics determined by him for mace, senna, leaves of Eucalyptus globulus, etc.

Dr. Britton spoke of the utility of this work and of its object, in behalf of the new edition of the U. S. Pharmacopœia.

The paper was followed by an early adjournment to facilitate the attendance of members upon the annual exhibit given by the New York Microscopical Society.

EDWARD S. BURGESS,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met April 7th, with thirty-two persons present. Professor J. Eliot Wolff spoke of the occurrence of tourmalines at Mt. Mica, Paris, Me., and gave an account of the locality, with a history of its discovery. Sev-

eral varieties were described; also the minerals formed in the rocks associated with the tourmalines. Two kinds of gem tourmaline were recognized and their occurrence in cavities or pockets noted. Professor Wolff showed a series of tourmaline crystals, including two of the largest yet discovered; also a number of the original plates illustrating Mr. Hamlin's 'History.'

Dr. Charles B. Davenport discussed the *rôle* of water in growth. Organic growth was defined as an increase in volume. The definitions given by others were reviewed and analyzed. The processes of growth were analyzed and the factors involved in growth noted. The experiments and observations of plant physiologists assign the principal *rôle* to water in the growth of plants. Experiments made to determine the percentage of water in the body of developing tadpoles at different stages show that growth is due chiefly to imbibed water. The *rôle* of water in the development of organisms and its bearing on the meaning of curves of growth were discussed in detail.

SAMUEL HENSHAW,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the evening of May 17, 1897, twenty-six persons present, a committee appointed at an earlier meeting presented a short biographic sketch of the late Dr. James N. Leete, for many years an active and influential member of the Academy.

Mr. J. B. S. Norton read a paper embodying the results of an examination into the effects of the tornado of May, 1896, on trees about St. Louis, in which it was shown that, while ordinary winds have some influence on the form and strength of trees, in strong winds uprooting is caused by wet soil, weak spreading roots and a large surface exposed to the wind. If the roots hold, breaks may occur in the trunk or branches, depending on the strength of the wood, the form of the tree, the mode of branching and the weight and resistance of foliage. While the edge of dry leaves presented to the wind offers little resistance, when foliage is wet and massed this may be very different. Local variations in these several factors make a comparison of different species difficult. It was shown that *Acer dasycarpum* was badly broken on account of its brittle wood and heavy foliage, while the weak-wooded *Tilias* and *Liriodendrons* were also broken. Spreading-topped trees, like *Ulmus Americana*, as a rule, were broken and uprooted, though the branches were only bent in the tougher-wooded individuals. As a general thing, conical trees, like *Ulmus campestris*, *Liquidambar* and most conifers and the strong-wooded oaks, were little injured. *Taxodium distichum*, from its slender form, strength and elasticity, was injured least of all. It was shown that after the tornado, which occurred early in the vegetative period, most of the trees continued the summer's growth by producing new foliage shoots. While a few died from the inability to secure food, others indicate injury by flowering and fruiting more profusely than usual. It was shown that some of the trees which were broken have already begun to show serious decay where the branches were removed, so that the final injury can hardly yet be measured.

The results observed here were compared by the speaker with those which have been reported from time to time in connection with severe storms elsewhere.

The paper was discussed by Mr. H. von Schrenk, who submitted some interesting specimens, slides and drawings illustrating the formation of a double ring in 1896, resulting from the refoliation of the branches denuded shortly after the season's growth had begun.

WILLIAM TRELEASE,
Secretary.

NEW BOOKS.

L'évolution régressive en biologie et en Sociologie. JEAN DEMOOR, LEAN MESSURT, ÉMILE VANDERVELDE. Paris, Alcan. 1897. Pp. 324.

Guide to the Genera and Classification of the North American Orthoptera found North of Mexico. SAMUEL HUBBARD SCUDDER. Cambridge, Edward W. Wheeler. 1897. Pp. 87.

The Entropy Temperature Analysis of Steam Engine Efficiencies. SIDNEY A. REEVE. New York, Progressive Age Publishing Co. 1897. Pp. 250.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, JUNE 11, 1897.

CONTENTS:

A Forest Policy for the Forested Lands of the United States.....893

The American Physiological Society: FREDERIC S. LEE.....900

The Introduction of New Terms in Geology: JOHN C. BRANNER.....912

Current Notes on Anthropology:—
Systematic Anthropology; Aboriginal Cultivation of Maize; The Grooved Stone Axe: D. G. BRINTON.....913

Notes on Inorganic Chemistry: J. L. H.....914

Scientific Notes and News:—
The Toronto Meeting of the British Association; The British Report on the Behring Sea Seal Fisheries; General.....915

University and Educational News.....918

Discussion and Correspondence:—
The Potter's Wheel in Ancient America: H. C. MERCER. *The Significance of Internal Secretion:* WESLEY MILLS. *Highhole Courtship:* HIRAM M. STANLEY. *A Question of Classification:* ROBT. T. HILL.....919

Scientific Literature:—
Johnson on The Materials of Construction: MANSFIELD MERRIMAN. *Davenport's Experimental Morphology:* J. P. MCMURRICH.....921

Scientific Journals:—
The Journal of Geology.....925

Societies and Academies:—
Torrey Botanical Club: N. L. BRITTON. *Alabama Industrial and Scientific Society:* EUGENE A. SMITH. *The Anthropological Society of Washington:* J. H. MCCORMICK.....925

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*FOREST POLICY FOR THE FORESTED LANDS OF THE UNITED STATES.**

THE RESERVED FOREST LANDS OF THE PUBLIC DOMAIN.†

THE peculiar topographical and climatic conditions of western North America would appear to make the preservation of its forests essential to the profitable and permanent occupation of the country. The precipitation of moisture west of the one hundredth meridian is unequally distributed throughout the year; the summers are hot and dry, and the whole territory, with the exception of the coast region of the northwest, is watered so imperfectly that forests are restricted to the slopes of high mountain ranges or to elevated plains and mesas, the valleys of the interior and of all the south being practically treeless. In all the interior and southern regions precipitation is insufficient for certain and profitable cultivation, and permanent agricultural prosperity can only be assured through irrigation. Much of the region is traversed

* Extracts from the report of the committee appointed by the National Academy of Sciences, transmitted by the President to Congress on May 25th. The report is signed by the members of the committee —Charles S. Sargent, Henry L. Abbot, A. Agassiz, Wm. H. Brewer, Arnold Hague, Gifford Pinchot, Wolcott Gibbs. It is dated from Arnold Arboretum, Harvard University, May 1, 1897.

† In the first part of the report the importance of the conservation of forests is considered in the light of European studies and the forest administration of foreign countries is reviewed.

by lofty mountain ranges well wooded at the north and sparsely wooded at the south. Their forests serve to collect, and in a measure regulate the flow of streams, the waters of which, carefully conserved and distributed artifically, would render possible the reclamation of vast areas of so-called desert lands. Irrigation systems have been undertaken in many localities under State or corporate control and have been prosecuted until their value has been amply demonstrated, although the one essential condition of their permanent success, the preservation of the forests on high mountain slopes, has been entirely neglected.

Under the authority of Section 24 of the Act of Congress, approved March 3, 1891, by which the President of the United States can withdraw from sale and entry and set apart as forest reservations parts of the public domain, whether wholly or in part covered with timber, seventeen forest reserves, with a total estimated area of 17,500,000 acres, were established prior to 1894. During the journey made by your committee last summer through the Western States and Territories it became impressed with the importance of extending this reserved area before further encroachments were made on the public domain; and on its return it prepared a short preliminary report, recommending the establishment of thirteen additional forest reserves with an estimated total area of 21,378,840 acres and roughly designating their boundaries. On the 6th of February this report was submitted by the Secretary of the Interior to the President, who, on the 22d of February, issued proclamations making the recommendations of your committee effective.

Fire and pasturage chiefly threaten the reserved forest lands of the public domain. In comparison with these the damage which is inflicted on them by illegal timber cutting is insignificant. Timber can only be cut profitably when the operation is conducted on a comparatively large scale; and large operations require roads and sawmills, and consequently the use of capital, and are usually easy to detect and arrest. The cutting of timber on the unreserved public lands under cover of bad laws or without a pretense of legal sanction causes, as we shall show later, serious losses to the government, but so far as we have been able to observe it does not now seriously menace many of the reserves.

Fires are particularly destructive to the forests of western North America. These are composed almost exclusively of highly resinous trees, which, when they grow beyond the influence of the moisture-laden air currents from the Pacific Ocean, ignite easily, and, burning fiercely on the surface, are quickly killed, while the flames sweep forward, leaving standing behind them the dead, although unconsumed, trunks to furnish material for later conflagrations and to intensify their heat. The climate, with its unequally distributed rainfall and intensely hot and dry summers and the peculiarly inflammable character of the forests, make forest fires in the West numerous and particularly destructive, and no other part of the country has suffered so seriously from this cause.

Nomadic sheep husbandry has already seriously damaged the mountain forests in those States and Territories where it has been largely practiced. In California and western Oregon great bands of sheep, often owned by foreigners, who are temporary residents of this country, are driven in spring into the high Sierras and Cascade ranges. Feeding as they travel from the valleys at the foot of the mountains to the the upper alpine meadows, they carry desolation with them. Every blade of glass, the tender, growing shoots of shrubs, and seedling trees, are eaten to the ground. The feet of these 'hoofed locusts,' crossing and

recrossing the faces of steep slope, tread out the plants sheep do not relish and, loosening the forest floor, produce conditions favorable to floods. Their destruction of the undergrowth of the forest and of the sod of alpine meadows hastens the melting of snow in spring and quickens evaporation.

The pasturage of sheep in mountain forests thus increases the floods of early summer, which carry away rapidly the water that under natural conditions would not reach the rivers until late in the season, when it is most needed for irrigation, and by destroying the seedling trees, on which the permanency of forests depends, prevents natural forest reproduction, and therefore ultimately destroys the forests themselves. In California and Oregon the injury to the public domain by illegal pasturage is usually increased by the methods of the shepherds, who now penetrate to the highest and most inaccessible slopes and alpine meadows wherever a blade of grass can grow, and before returning to the valleys in the autumn start fires to uncover the surface of the ground and simulate the growth of herbage. Unrestricted pasturing of sheep in the Sierras and southern Cascade forests, by preventing their reproduction and increasing the number of fires, must inevitably so change the flow of streams heading in these mountains that they will become worthless for irrigation.

A study of the forest reserves, in their relations to the general development and welfare of the country, shows that the segregations of these great bodies of reserved lands can not be withdrawn from all occupation and use, and that they must be made to perform their part in the economy of the nation. According to a strict interpretation of the rulings of the Department of the Interior, no one has a right to enter a forest reserve, to cut a single tree from its forests, or to examine its rocks in search of valuable minerals. Forty million acres of land are thus theoretically shut out from all human occupation or enjoyment. Such a condition of things should not continue, for unless the reserved lands of the public domain are made to contribute to the welfare and prosperity of the country they should be thrown open to settlement and the whole system of reserved forests abandoned. Land more valuable for its mineral deposits, or for the production of agricultural crops, than for its timber should be taken from the reservations and sold to miners and farmers; the mature timber should be cut and sold; settlers within or adjacent to the boundaries, unable to procure it in other ways, should be authorized to take such material from reserved forests as is necessary for their needs, and prospectors should be allowed to search them for minerals.

But it must not be forgotton that the public domain of which these reserves form a part belongs to the people of the whole country, and not to those of any one section. It is right, therefore, that the forest reserves should be managed for the benefit of the people of the whole country, and not for any particular class or section. Steep and elevated mountain slopes should not be cleared of their forests for the sole benefit of the prospector or the miner, because this by its influence on water flow might mean permanent injury to persons living hundreds of miles away. A few foreign sheep owners should not be allowed to exterminate great forests at the expense of the whole country, and prospectors and miners should not be permitted to burn willfully or carelessly forests in which all classes of the community are equally interested.

Our examination of the Western forests shows that the existing methods and forces at the disposal of the Interior Department are entirely inadequate to protect the for-

ests of the public domain. Civil employees, often selected for political reasons and retained in office by political favor, insufficiently paid and without security in their tenure of office, have proved unable to cope with the difficulties of forest protection, and the reserves are practically unguarded. Excluded from the provisions of the general land laws and without protection, they invite trespass of every kind and demoralize without benefiting the community. It is evident that if the government proposes to protect public property in the reserves and to enforce any laws or regulations which may be enacted for their administration, the assistance of the military must be called in until an organization can be developed in the Interior Department for the protection, management and improvement of all reserved government forest lands; for without such assistance the experience of the past clearly shows that it is idle to hope that fires can be restricted, pasturage abolished and timber cutting and mining regulated in the reserves; and if this can not be done their forests will sooner or later be ruined and the objects defeated for which they have been established.

PROPOSED SYSTEM OF FOREST ADMINISTRATION.

It has been shown that the preservation and judicious management of the forests on those portions of the public domain which are unsuited for agriculture are of great importance for the flow of rivers needed for the irrigation of arid districts, and to furnish forest products for settlers on adjacent arable lands, and for mining operations. The cheapness of forest products in the United States, and the length of time required to produce crops of timber in the West, will make the investment of the capital of individuals in silvicultural operations, for the present at least, a doubtful enterprise in those States and Territories where the public domain is now principally situated; and silviculture in western North America will only be really successful under sustained government control and administration; for, dealing with crops which often do not reach maturity until the end of one or two centuries, it can only be made profitable by carrying out without interruption and under thoroughly trained officers, plans which must often be followed during the lives of several generations of men. This stability and continuity of management can only be secured by a permanent government administration composed of officers of the highest character, entirely devoted to duty.

Annual taxes on the land of individuals demand annual income; and to avoid or meet this burden of taxation land which should always remain covered with forests is often denuded before the requirements of commerce justify it, or is devoted to uses for which it is ill adapted. Private ownership, for example, of the redwood-bearing land of the California coast region, the most productive forest land in the world, has resulted in this land, which should remain covered with forest for all time, being rapidly converted into indifferent pasturage. The fee of lands which are most valuable for the production of timber should remain vested in the general government, and these lands, if they are managed wisely, can be made to supply forest material indefinitely to the agricultural and mining populations of adjacent districts and to improve in productiveness and value.

Ultimate self-support of a government forest administration is possible in the United States, and it may be expected to yield a permanent income if the national forests are managed with the intelligence, thrift and honesty which characterize the forest administration in Germany, France and other European countries. At first, however, the cost of administration will

exceed the receipts, as is almost invariably the case in important economic reforms, but outlays may be expected to diminish in proportion as the administration is faithful, intelligent and honest.

To inaugurate at once a complete system of forest administration would be to attempt more than is wise or feasible at this time; but the necessity of prompt action for the protection of the forest reserves from fire, illegal pasturage and other depredations is urgent, and efficient temporary police measures are needed immediately. A plan for the temporary care of the forest reserves may be wisely based on the experience gained in the management of the national parks. This clearly shows that it is possible to protect forests in the most exposed and difficult parts of the public domain with small bodies of troops; whereas, before soldiers were detailed to police the Yellowstone National Park, all efforts to manage it by civil officers of the government had shown the futility of any attempts at control which did not rest on the moral and physical support of the army.

The primary object of such temporary management would not be to produce a revenue, but to protect the reserves against fire and depredation. It should be the duty of the superintendents to issue passes to persons desirous of entering or crossing them, and to keep a careful record of the names and residences of all such persons. Sheep should be wholly excluded from the reserves, and cattle should be admitted only in moderate numbers and when the property of actual settlers on adjacent lands.

The fundamental principle of any government system of forest management should be the retention of the fee of forest lands, and the sale of forest products from them at reasonable prices, under regulations looking to the perpetual reproduction of the forest. While it is not desirable, perhaps, that the government in the immediate future should enter into competition with the private owners of forest lands, it is evident that ultimately the sale of forest supplies from the government timber lands should not only cover all expenses of government forest management, but produce a steadily increasing income.

Upon officers charged with the administration of the government forests will devolve the care of immensely valuable public property, its improvement under the best established scientific methods, police responsibility of exceptional delicacy, surveys, the construction of roads and engineering works for the protection of mountain slopes, and the control of numerous agents widely separated and not easily trained to habits of discipline. Many of these duties are essentially military in character, and should be regulated for the present on military principles. Wise forest management calls for technical knowledge which must be based on a liberal scientific education. The forest officers must be men of the highest personal character, who can be trusted to avoid participation in any private business connected, however remotely, with forest products. To secure the service of men qualified to meet these several requirements will call for liberal remuneration and permanent tenure of office.*

Topographical and economic surveys upon which it would have been possible to establish scientifically the proper boundaries of the reserved lands do not exist and their limits have been laid down roughly with the idea that they would be modified as soon as it was possible to determine accurately what portions were more valuable for the production of minerals and for agriculture and grazing than for their timber

*A plan for a permanent organization is then recommended, a bill to protect and administer public forest reserves being given in an appendix.

growth, and that such lands would then be opened to entry and settlement. In all the forest reserves visited by your committee it saw opportunities to improve their boundaries and found lands which can not be permanently reserved without inflicting serious hardships and losses on the community. Only a small portion of the White River Plateau Timber Land Reserve in Colorado, for example, is forest land, the remainder being covered with grasses and scattered clumps of oak bushes. Such land is, of course, most valuable for pasturage, and its withdrawal from use cripples the important cattle industry of the region. In the Washington Forest Reserve and in the Cascade Forest Reserve are mineral deposits which can not wisely be held from entry, and near the borders of others there are lands more valuable for agriculture or fruit growing than for other purposes.

It is evident that such lands should be taken from the forest reserves as soon as it is practicable to do so, but before this can be done safely those parts of the public domain which have been reserved, or which may be reserved, should be accurately surveyed and carefully mapped. As the United States Geological Survey is the only Bureau in the Department of the Interior equipped for this work, it can probably most conveniently make these surveys. Their proper interpretation is a matter of the greatest importance, for on the men who undertake it will devolve the duty of establishing the final boundaries of the reserved forest lands of the public domain. Enormous interests are involved in these final decisions, and this work can be entrusted only to men of the highest integrity, intelligence and public spirit. Efforts will certainly be made to improperly influence their judgment, and they will be subjected to severe temptations. The power to open any part of the reserved lands to settlement is in the hands of the President of the United States, but he will necessarily base his decisions in such matters on the reports and recommendations of the experts who are to study the results of the surveys made under the direction of the Geological Survey.

To provide for this important duty, we recommend that the President be authorized to appoint a commission to be known as the board of forest lands, to consist of an officer of the Engineer Corps of the Army, a member of the Geological Survey, a member of the Coast Survey and two persons not connected with the public service, and that it shall be the duty of this board to determine, with the aid of actual surveys and such other examinations as may be found necessary, the boundaries of those parts of the public domain which should be retained permanently by the government as forests, and that upon its recommendations the President should be authorized to open all other lands to entry and sale. It is believed that the character of this commission can be best maintained at the highest level by limiting the remuneration of the two members unconnected with government service to their actual expenses.

In all the forest reserves individuals have acquired more or less perfect title to land, and as they may claim that their rights are interfered with, or the value of their holdings diminished by the reservation from entry of adjacent lands, opportunity should be given them to exchange on an equitable basis their lands or rights for those of similar character outside the reservations. Several of the forest reserves are within the limits of land grants made to railroad corporations, and it should be possible for the Secretary of the Interior to arrange with these corporations to exchange their holdings within the reservations for similar unreserved lands.*

* A section on the unreserved forest lands of the public domain shows the harm that has resulted from the working of the land laws.

ADDITIONAL NATIONAL PARKS.

Parts of two forest reserves contain features of supreme natural beauty, and can best be preserved for the enjoyment and instruction of the world by creating them national parks and governing them under the rules and regulations which have proved successful in protecting the Yellowstone National Park. The first of these is the upper slopes of Mount Ranier, in Washington, with its glaciers, its alpine meadows clothed with flowers, and the fringe of forest which maintains a precarious foothold on the steep ridges below the line of its perpetual snows. This mountain is one of the highest and most beautiful in North America, and outside Alaska its glaciers are unrivaled in magnitude and interest in the United States. Memorials have been presented to Congress by the American Association for the Advancement of Science, the Geological Society of America, the Sierra Club and the Apalachian Mountain Club favoring the establishment of this national park, and an act setting aside certain lands for it was passed by the Fifty-fourth Congress at its second session; but the bill, by extending to it the mineral-land laws, might have destroyed its scenic value, and it did not receive Executive sanction.

The second spot which we believe should be made into a national park is that portion of the Grand Canyon Reserve in Arizona which is immediately adjacent to and includes the walls of the canyon itself. These two localities, Mount Ranier in Washington and the Grand Canyon of the Colorado in Arizona, are each in its particular way unsurpassed in interest. Their natural wonders should be preserved without further defacement than is necessary to make them easily accessible to the people; and unless mining is prohibited in their immedite neighborhood, and unless they can be strictly guarded against fires, their scenic value will be seriously impaired. As this protection can only be secured by the adoption of the rules and regulations similar to those which govern the national parks, we recommend the establishment of a Ranier national park and a Grand Canyon national park.

CONCLUSIONS AND RECOMMENDATIONS.

The Secretary of the Interior, in his letter of February 15, 1896, asked the Academy whether "it is desirable and practicable to preserve from fire and to maintain permanently as forest lands those portions of the public domain now bearing wood growth for the supply of timber."

Your committee is of the opinion that it is not only desirable but essential to national welfare to protect the forested lands of the public domain, for their influence on the flow of streams and to supply timber and other forest products; and that it is practicable to reduce the number and restrict the ravages of forest fires in the Western States and Territories, provided details from the Army of the United States are used for this purpose permanently, or until a body of trained forest guards or rangers can be organized. It does not believe that it is practicable or possible to protect the forests on the public domain from fire and pillage with the present methods and machinery of the government.

In answer to the second question submitted by the Secretary of the Interior, "How far does the influence of forests upon climate, soil, and water conditions make desirable a policy of forest conservation in regions where the public domain is principally situated?" It is the opinion of your committee that, while forests probably do not increase the precipitation of moisture in any broad and general way, they are necessary to prevent destructive spring floods, and corresponding periods of low water in summer and autumn when the agriculture of a large part of western

North America is dependent upon irrigation.

The answer to the third question, "What specific legislation should be enacted to remedy the evils now confessedly existing?" will be found in the series of proposed bills appended to this report. They present the following recommendations:

1. That the Secretary of War, upon the request of the Secretary of the Interior, shall be authorized and directed to make the necessary details of troops to protect the forests, timber and undergrowth on the public reservations, and in the national parks not otherwise protected under existing laws, until a permanent forest bureau in the Department of the Interior has been authorized and thoroughly organized.

2. That the Secretary of the Interior shall be authorized and directed to issue the necessary rules and regulations for the protection, growth and improvement of the forests on the forest reserves of the United States; for the sale from them of timber, firewood and fencing to actual settlers on and adjacent to such reserves, and to the owners of mines legally located in them for use in such mines; for allowing actual settlers who have no timber on their own claims to take from the reserves firewood, posts, poles and fencing material necessary for their immediate personal use; for allowing the public to enter and cross the reserves; for granting to county commissioners rights of way for wagon roads in and across the reserves; for granting rights of way for irrigating ditches, flumes and pipes, and for reservoir sites; for permitting prospectors to enter the reserves in search of valuable minerals; for opening the reserves to the location of mining claims under the general mineral laws; and for allowing the owners of unperfected claims or patents, and the land-grant railroads with lands located in the reserves, to exchange them under equitable conditions for unreserved lands.

3. That a bureau of public forests shall be established in the Department of the Interior, composed of officers specially selected with reference to their character and attainments, holding office during efficiency and good behavior and liberally paid and pensioned.

4. That a board of forest lands shall be appointed by the President to determine from actual topographical surveys to be made by the director of the Geological Survey what portions of the public domain should be reserved permanently as forest lands and what portions, being more valuable for agriculture or mining, should be open to sale and settlement.

5. That all public lands of the United States more valuable for the production of timber than for agriculture or mining shall be withdrawn from sale, settlement and other disposition and held for the growth and sale of timber.

6. That certain portions of the Rainier Forest Reserve in Washington and of the Grand Canyon Forest Reserve in Arizona shall be set aside and governed as national parks.

THE AMERICAN PHYSIOLOGICAL SOCIETY.

The fourth special meeting of the American Physiological Society was held in Washington, D. C., on May 4, 5 and 6, 1897, in conjunction with the fourth Congress of American Physicians and Surgeons. The sessions were held at the Columbian University. The following communications were presented and discussed:

A new form of Gastric Cannula. W. T. Porter.

Phlorhizin Diabetes in Dogs. G. Lusk.

The continued frequent administration of phlorhizin to dogs produces in them a form of diabetes in which, during starvation or meat nutrition, sugar is eliminated in the

urine in the average proportion of 3.75 g. to every one gram of nitrogen. If we neglect the small quantity of nitrogen in the fæces, this means that for every 6.25 g. of proteid destroyed in the body 3.75 g. of sugar may be obtained, or sixty per cent. of sugar from the proteid molecule. This sugar is completely fermentable with yeast; it is only very slightly affected by boiling with 10% hydrochloric acid, and it rotates polarized light as does dextrose. If dextrose be fed to dogs suffering from this form of diabetes, it is almost quantitatively eliminated in the urine. If levulose and galactose be fed, dextrose appears in increased quantity in the urine, but no levulose or galactose. The production of phlorhizin diabetes in starving dogs may cause an increased proteid metabolism of four hundred and fifty per cent.

Further Contributions to the Physiology of Deglutition. S. J. MELTZER.

Kronecker and Meltzer have advanced the view, on the basis of convincing experiments, that in the act of deglutition fluids and semi-solids are not carried down by peristalsis, but are rapidly squirted down the œsophagus by the rapid contraction especially of the mylohyoid muscles. After M. discovered the presence of the 'squirting murmur' opposite the cardia about six seconds after the beginning of deglutition, the authors supplemented their view by the assumption that the fluid remains above the cardia until it is carried into the stomach by the peristaltic wave. In support of this latter view, which was contradicted by some writers, Meltzer reported some experimental observations. In rabbits and dogs the cardiac aperture of the stomach was directly observed while the deglutition was going on, and it was found that the entire swallowed mass was carried into the stomach by peristalsis only. Furthermore, by the removal of a few ribs and by the introduction of a 'speculum' into various parts of the thorax the behavior of the entire thoracic œsophagus during deglutition could be satisfactorily scrutinized. Meltzer summarizes his observations as follows: During each act of deglutition liquid and air are rapidly squirted down into the œsophagus to a point about half way between the bifurcation of the trachea and the diaphragm and remain there until the peristaltic wave carries them down into the stomach.

Movements of the Alimentary Canal. H. P. BOWDITCH.

This paper was a brief preliminary report upon the results of some experiments performed in the laboratory of the Harvard Medical School by Messrs. A. Moser and W. B. Cannon, medical students, on the movements of the alimentary canal as studied by means of the X-rays and a fluorescent screen.

For this purpose moist bread, meat, mush or viscid fluids were mixed with subnitrate of bismuth. Food thus prepared is visible during the process of deglutition, and, if given in sufficient quantities, serves to outline the stomach and to render its peristaltic movements visible. Observations on a goose showed that a bolus of such food, swallowed without water, moved slowly and regularly down the œsophagus. There was no evidence of squirting. The movement was slower in the lower part of the neck. When water was given with the boluses the movement was irregular. Viscid fluids were swallowed in the same peristaltic way.

Experiments with a cat showed that a bolus of meat moved down the œsophagus regularly with no interruption or shooting movement. In the neck and from the level of the apex of the heart to the stomach the rate was lower than in the intermediate region. When water was added, the bolus shot down at irregular intervals, but at the level of the apex of the heart the rate

always slackened and the bolus moved slowly into the stomach. Thin mush and viscid fluids were also carried down by peristalsis. Large boluses stopped in the lower half of the thorax with each expiration, and descended with each inspiration. The examination of a cat's stomach filled with food mixed with subnitrate of bismuth showed the occurrence of a constriction at about the middle of the organ, which slowly moved towards the pylorus and was followed by other peristaltic waves at intervals of about ten seconds. The food thus pressed onward toward the pylorus did not pass into the duodenum, but returned apparently through the central portion of the organ, since the wave of constriction was never sufficient to obliterate the whole cavity.

The Reaction of some Animal Fluids. R. H. CHITTENDEN.

There is a general assumption on the part of physiologists that the alkaline reaction obtained with red litmus, in the case of many animal fluids, is due in great part to the presence of sodium carbonate. In many cases this assumption is quite erroneous. Thus, a large number of examinations of fresh bile from many species of animals shows that the fluid never contains any sodium carbonate; although alkaline to red litmus, the fluid is invariably acid toward phenolphthalein, 1 gram of bile requiring on an average 0.4 milligram NaOH to neutralize the free acid or acid salts present. With lacmoid, however, the reaction is invariably alkaline, thus showing the absence of free acids. The salts Na_2HPO_4 and NaH_2PO_4 undoubtedly play an important part in determining the behavior of the bile toward different indicators. As a rule, 5 c.c. of fresh ox bile require 0.5 c.c. of $\frac{1}{10}$ normal NaOH solution to render the fluid neutral to phenolphthalein and about 3.0 c.c. of $\frac{1}{10}$ normal HCl solution to make the fluid neutral to lacmoid.

Human mixed saliva is likewise acid to phenolphthalein; on an average 5 c.c. of filtered saliva require 0.6 c.c. of $\frac{1}{10}$ normal NaOH solution to render the fluid neutral to phenolphthalein. Toward most other indicators the fluid reacts alkaline, viz., with rosolic acid, litmus, lacmoid, congo red, alizarin, etc.

The submaxillary saliva of the dog, however, obtained on stimulation of the chorda tympani, is faintly alkaline to phenolphthalein, but 5 c.c. of the fluid generally require 1.3 c.c. of $\frac{1}{10}$ normal HCl solution to render the fluid neutral to litmus and lacmoid. Succus entericus and pancreatic juice undoubtedly owe their alkalinity in great part to the presence of sodium carbonate and bicarbonate.

The Proteolytic Action of Papain. R. H. CHITTENDEN.

The results of some quantitative experiments made by Mr. McDermott, designed to throw light upon the relative peptone-forming power of papain, were reported. The following experiment with coagulated egg-albumen, in the presence of 0.25 per cent. Na_2Co_3 and chloroform at 40°C., may serve as an illustration of the character of the results.

	24 hours digestion.	48 hours digestion.
Undissolved residue (mostly antialbumid)	35.8 per cent.	32.8 per cent.
Neutralization precipitate	1.7 "	0.9 "
Proteoses	26.7 "	24.3 "
Peptones	35.8 "	42.0 "

Especially noticeable is the behavior of deutero-albumose as formed by papain, when injected into the blood of a dog, in the proportion of 0.5 gram albumose per kilo of body weight. Unlike the corresponding albumose formed in gastric digestion, this substance does not appear to affect blood pressure, neither is there any noticeable effect upon the temperature of the body. Coagulation of the blood, however, is somewhat retarded, although not to the same extent as with ordinary deutero-

albumose. Diuresis, on the other hand, is very marked and in fifty minutes after the injection of the albumose fully 50 per cent of the substance is found in the urine which rapidly accumulates in the bladder. On removing the albumose from the urine by saturation of the fluid with ammonium sulphate a strong reaction for true peptone can be obtained, thus showing that in the elimination of the albumose from the body a certain amount of the substance is transformed into peptone, presumably in the epithelial cells of the kidney.

A Search for Pexin. J. W. WARREN.

The presence of pexin, the milk curdling ferment (otherwise 'labferment,' or 'rennin') in the digestive apparatus of non-mammalian vertebrates has been fully demonstrated. In the Bryn Mawr laboratory investigations have been made by various students which help to make more probable the opinion that there is no vertebrate in which the curdling ferment does not exist. A similar substance is known to occur in many plant juices and also in certain microorganisms. This wide distribution of such a peculiar material or materials raises interesting questions as to its significance and also concerning the value of the clotting of milk as incidental to the digestive process.

Does such a ferment exist among invertebrates? Some little time ago the stomachs of a few lobsters were examined in the Bryn Mawr laboratory. Chloroform extracts were prepared and were found to have no curdling action, nor were they made active by acidulation and subsequent neutralization in the usual manner. When neutralized with calcium carbonate (which is probably equivalent to the addition of soluble calcium compounds) the liquid acquired the power of clotting milk. Recently the question has been taken up again. Fresh earthworms were carefully washed, chopped into fine pieces and extracted by chloroform water. This infusion was inert, but became active after treatment which is known to transform the zymogen. In another series the digestive tract was isolated, opened and thoroughly washed, and then put into chloroform water. This extract could not be made to coagulate milk by any of the methods which are ordinarily successful for the demonstration of pexin or its forerunner, pexinogen. This divergence may be due to the accidental exhaustion of the glands in the second series, or perhaps to the presence of bacteria in the contents of the digestive canal of the first lot of worms. Other less probable explanations might be given. The digestive apparatus of oysters and clams has also been examined in a preliminary way, but thus far only with quite negative result.

Note upon the Physiological Effects of Injections of Extracts of the Hypophysis Cerebri. W. H. HOWELL. Read by title.

Extracts were made of the glandular or anterior lobe of the hypophysis cerebri and the posterior or infundibular lobe, and the effects were tested separately by injections into the circulation of dogs under the influence of various narcotics. Usually the extracts were made by rubbing up the portion used in a few drops of glycerine and diluting this mixture, after it had stood several hours, with a greater or less quantity of normal saline. It was found that extracts thus made of the glandular lobe have no distinct or constant effect on the circulatory organs, while the extracts of the infundibular lobe have a marked influence on the heart rate and blood pressure. When the vagi were intact this effect consisted usually in a rise of pressure, followed quickly by a temporary fall during which the heart rate remained unchanged or showed some acceleration, and this was followed by very slow and powerful heart beats lasting from a few minutes to half an hour or more, during which the pressure

rose gradually to a maximum above the normal pressure and then declined more slowly. In these experiments the maximum rise of pressure varied from 20 to 60 mms. Hg. and the maximum reduction in pulse rate varied from 40 to 60 per cent. of the rate existing before the injection. When the vagi were cut, or the animal was atropinized, the injections caused a rise of pressure, followed in some cases by a temporary fall, and then a more gradual but pronounced rise, together with a slower and more powerful heart beat. Under these conditions the maximal rise of pressure varied from 50 to 90 mm. Hg., while the maximal slowing of the pulse ranged from 17 to 35 per cent. of the rate before injection. Animals deeply under ether alone behaved in this respect like animals with the vagi cut. The slowing of the heart caused by extracts of the infundibular lobe seems, therefore, to be due in part to an effect upon the cardio-inhibitory center and in part to a peripheral effect, differing in this latter respect from suprarenal extracts. The effect upon the blood pressure seems to be due mainly to a peripheral effect, since it can be obtained readily in animals with the cord severed from the medulla and with part of the thoracic cord extirpated. As compared with extracts of the suprarenal bodies the effect of these extracts are characterized by their long duration, and the longer interval of time that must be allowed in order to obtain a similar effect from a second injection.

A Contribution to the Physiology of the Suprarenal Capsules. G. P. Dreyer.

The most striking effects of the injection of extracts of the suprarenals into blood vessels are general vaso-constriction with rise of blood pressure, slowing of pulse with intact vagi, and acceleration of pulse with vagi cut or paralyzed by atropin. Is the active substance contained in such extracts a product of the normal activity of the gland cells, *i. e.*, a true internal secretion, or the result of post-mortem changes? If the former a greater amount of it would be contained in blood coming direct from the gland than in blood taken from some other systemic vein, and this increase might be detected by the effects produced by intravenous injections of adrenal blood as compared with the effects of similar injections of blood from other veins. The author has made a series of such experiments on ten anæsthetized dogs. Femoral blood and adrenal blood were alternately injected into the jugular vein in quantities ranging from 5 c.c. to 40 c.c., either into the same animal from which it had been taken or into a fresh animal. In every case the adrenal blood gave an appreciable rise of pressure, in some cases exceeding 40 per cent., while the inhibition of the heart before section of the vagi, or the acceleration after atropine injection, were practically constant phenomena. The variation in the extent of the effects must probably be ascribed to differences in the secretory activity of the gland in the different dogs. Furthermore, in general, the effect was greater the slower the outflow from the adrenal vein, and apparently greater when the injection was into a dog other than the one yielding the adrenal blood. Blood from the femoral vein gave negative results.

Gases of the Blood during Nitrous Oxide Anæsthesia. G. T. Kemp.

The author's previous experiments have shown that when enough air or oxygen is mixed with nitrous oxide to keep an animal alive, anæsthesia can be maintained for a considerable length of time without risk of life to the animal. When nitrous oxide is replaced by nitrogen, the anæsthesia passes off. This shows that nitrous oxide possesses specific anæsthetizing properties not possessed by nitrogen.

A more thorough knowledge of the condition of the system during nitrous oxide

anæsthesia has been obtained by drawing blood for analysis while the animal was connected with a kymograph and breathing N_2O + air or N_2O + pure oxygen. The analysis of the blood gases shows that even when the animal was so deeply anæsthetized as to endure stimulation of a sensory nerve without pain the blood contained enough oxygen to support life. The CO_2 in the blood was greatly diminished. The average amount of N_2O in the blood during anæsthesia was 28 vols. per cent. (gas at 0° C. and 760 mm.). A study of the respiratory exchange indicates that the metabolism was lowered and that the system adapted itself to the small amount of oxygen present in the inspired air. The theory frequently found in text-books that nitrous oxide anæsthetizes solely by asphyxia is erroneous, and the safety of nitrous oxide compared with chloroform or ether merits that nitrous oxide, properly mixed with oxygen, be given a wider trial even in major surgery.

On the Production of Idioventricular Rhythm in the Mammalian Heart. A. R. CUSHNY.

The method employed was the stimulation of the ventricle in the dog by single induction shocks at a definite point in the relaxation. As a general rule the ventricular rhythm was accelerated, and both contraction and relaxation became imperfect. Not infrequently, however, the ventricular systole was stronger during stimulation than before and afterwards, and this was explained as being due to the dislocation of the auriclo-ventricular rhythm. In the great majority of cases the auricle assumed the accelerated ventricular rhythm, and the auricular systole became remarkably weak. This weakness is due in part to the acceleration of the rhythm, in part to the fact that the auricle contracts while the ventricle is in full contraction and has, therefore, to work against much greater resistance than normally.

The Cause of the Heart Beat. W. T. PORTER.

Any part of the dog's ventricle, even the apical fourth, will contract rhythmically, when cut away from the remainder of the ventricle and fed with warmed, defibrinated dog's blood through a cannula placed in the coronary artery ramifying in the extirpated part. Hence: (1) the cause of the rhythmic contraction of the ventricle lies within the ventricle itself; (2) the cause of the rhythmic contraction is not in a single localized coordination center; (3) the coordination mechanism, whatever it may be, is present in all parts of the ventricle; (4) the integrity of the whole ventricle is not essential to the coordinated contraction of a part of the ventricle; (5) assuming the correctness of the general belief in the absence of nerve cells from the apical half of the ventricle, the rhythmic coordinated contraction of the ventricle is not dependent on nerve cells.

A thin piece of the beating ventricle of the dog's heart *in situ* in the living animal may be partly severed from the apical portion in such a way that the isolated piece remains attached to the remainder of the ventricle only by its nutrient vessels, all muscular connections being cut. The heart and the isolated piece continue to contract. On slowing the heart by vagus excitation, the rhythmical contractions of the isolated piece may be watched without difficulty. Their rhythm then differs from that of the remainder of the heart. It follows that the rhythmic contractions of the isolated mammalian apex are not due to changes in the blood during its defibrination.

The Recovery of the Mammalian Heart from Fibrillary Contractions. W. T. PORTER.

Recovery of the dog's heart, or of any isolated part of it, from strong fibrillation produced either by electrical stimulation, mechanical insult, or sudden deprivation of blood supply, is secured by feeding the part with defibrinated dog's blood through its coronary artery.

On the Relation between the Beat of the Ventricle and the Flow of Blood through the Coronary Arteries. W. T. Porter.

When an isolated piece of dog's or cat's ventricle is fed through the coronary artery, the flow from the veins is seen to be greater during systole than during diastole. In an extirpated heart, supplied with blood at a constant pressure through the coronary arteries, a pulse synchronous with the systole may be observed in the superficial auricular veins before and after their connection with the coronary sinus is severed. A similar but less marked pulse can be demonstrated in the coronary arteries. When a vein on the surface of a dog's ventricle *in situ* in the living animal is incised, and the heart slowed by vagus excitation, the flow from the cut vein is much increased during ventricular systole. These observations show that the contraction of the cardiac muscle compresses the veins, and to a less extent the arteries, in the substance of the heart. The systole must, therefore, facilitate the circulation through the heart muscle. The minimum manometer fails to show a negative pressure in the coronary arteries. The ventricle acts on the coronary circulation as a force pump, and not, to any noticeable extent, as a suction pump.

The Circulation through the Vessels of Thebesius. W. T. Porter (for F. H. Pratt).

In nearly all experiments the freshly excised heart of the cat has been used. The auricles are tied off from the ventricles, and both coronary arteries ligated. A large cannula is introduced into the right ventricle through the pulmonary artery and secured by a ligature. This cannula is now supported vertically, so that the heart shall hang from its lower end, and defibrinated blood poured in from the top, so as to fill the ventricle and rise in the cannula to a height of several inches. The ventricle distends, and all the coronary veins become filled with blood; the coronary arteries remain empty. The ventricle begins to contract rhythmically, slowly at first, but gradually attaining the normal rate. Suspending the heart in warm normal saline solution facilitates the action. The blood within the ventricle and in the veins becomes venous, and, if contractions are to be sustained, must periodically be renewed. If a vein is opened, a small but steady outflow of blood occurs. Increasing the load beyond that furnished by a blood column of four or five inches lowers the force of contraction. Contractile activity may be kept up by this method for some time. Eight hours after excision is the maximum duration so far obtained, and in this case the ventricle was still active when left.

The experiments above described indicate plainly a nutritive phenomenon; the blood becomes reduced, and must be renewed in order to sustain contraction. That the contractions are not due to mere mechanical stimulus is proved by the fact that Ringer's solution fails to carry on the process. A genuine circulation exists between the ventricular cavity and the coronary veins through the vessels of Thebesius. The possibility of a nutrition from the ventricles direct may serve to explain some cases in which thrombosis or other stoppage of the coronary arteries has failed to destroy the normal activity of the heart. This method of nutrition bears a strong resemblance to that found in the frog.

The Innervation of the Heart of the Opossum (Didelphys virginiana). Reid Hunt (with D. W. Harrington). Read by title.

(1) *Vagus.* Standstill of the heart is easily produced by stimulation of the peripheral end of the vagus; the duration of the standstill is greater than that usually observed in other mammals. The heart beats slowly for some time after the cessation of the stimulus, *i. e.*, there is a long after-effect. By continuous weak stimula-

tion of the vagus the heart can be kept beating at a remarkably slow rate for some time and yet the blood pressure remain near or even rise above the normal.

(2) *Depressor.* In most cases there is a separate depressor nerve; it is usually formed by two roots, one from the superior laryngeal nerve, and the other from the ganglion of the trunk of the vagus. Stimulation of this nerve gives results entirely similar to those observed in the rabbit, *viz.*, fall of blood pressure and a reflex slowing of the heart.

(3) *Accelerator nerve.* The anatomical relations of these nerves resemble in general those found on the dog; stimulation of them causes marked increase in the heart rate and very frequently irregularity of the ventricles from their failure to follow all the auricular beats. Stimulation of the accelerators while the heart is being slowed by stimulation of the vagus causes an increase in the heart rate.

Some Experiments on the Lobster's Heart. REID HUNT. Read by title.

I. *Some General Properties of the Cardiac Muscle of the Lobster* (with Messrs. Bookman and Tierny). 1. The latent period caused by electrical stimulation is very short, varying according to the condition of the heart from $\frac{1}{25}$ to $\frac{1}{100}$ of a second. 2. The heart responds to stimulation during every phase of a contraction, whether this is spontaneous or has been caused by previous stimulation, *i. e.*, there is no refractory period (the latent period, however, was not investigated as to this point). 3. A true summation of contractions is easily produced; one contraction can be superimposed upon another until the resulting contraction is many times higher than any single (maximal) contraction. 4. Complete tetanus is readily produced, as has been observed by Howell for the crab's heart; the number of stimuli necessary to produce it varies greatly according to the condition of the heart, 4 to 6 per second being sufficient as a rule. 5. The height of the contraction varies (up to a maximum) with the strength of the stimulus, *i. e.*, the 'all or nothing' law does not hold.

II. *The Effect of Changes of Temperature upon the Lobster's Heart* (with Messrs. Lyman and Williams). Most of the results were obtained with hearts removed from the body and placed in the lobster's defibrinated blood; the temperature of the blood could be altered as desired. The force and frequency of the beat increased as the temperature was lowered from that of the room (18° C.) to about 13° C., which seemed to be, as a rule, the optimum temperature for hearts in the body as well as for the isolated ones. As the temperature was lowered still farther, the beats became more rapid but feebler; the temperature was not carried below 2° C., but the heart beat well at this temperature. When the temperature was raised above the optimum, the beats became fewer and irregular and the heart went into heat standstill at a remarkably low temperature; upon cooling it beat again, unless it had been exposed to a too high temperature. The temperature at which a standstill occurred varied according to the condition of the heart; previous cooling and long exposure caused it to occur at very low temperatures. The heart was never observed to beat above 22° C., although it responded to electrical stimulation up to 27°. The crab's heart goes into standstill at a much higher temperature (45–50° C.). Sudden changes of temperature caused a temporary acceleration. A moderate degree of tension on the heart caused a much more rapid beat.

The Innervation of the Heart of the Guinea Pig. D. W. HARRINGTON.

In the guinea pig the average blood pressure in the carotid artery is 78.25 mm. of mercury; the average rate of heart beat,

200 per minute; the average number of respirations at a temperature of 68° F., 72. Both vagus nerves are inhibitory and apparently equally so. They do not seem to be in a state of tonic activity. Stimulation of the central end of one vagus gives the usual slight fall of blood pressure, with slowing of the heart if the other nerve be intact. Stimulation of the peripheral end gives different results in different seasons of the year. In the fall and early winter months vagus excitation results in a gradual and moderate slowing but never stoppage of the heart, a gradual and moderate fall of blood pressure, and on cessation of stimulation a gradual return to the normal rate and blood pressure. In the late winter and spring months even with weak stimulation the heart is easily and suddenly stopped and held at a standstill; the fall of blood pressure is sudden and marked; the rise of pressure is generally sudden and often far above the normal, with a following gradual fall below the normal level. The tracings show considerable irregularity. A marked depression in the vitality of the animals was noticed at this time, which seems to be associated with the seasons and to be of practical importance, in view of the fact that guinea pigs are used so largely in experimental pathology. The heart 'escapes' quickly from vagus stimulation, but, on the whole, the latter seems to be deleterious to cardiac action, leaving the heart weaker and the blood pressure lower than normal. After escape from one vagus has commenced, stimulation of the other usually brings the heart to a standstill a second time. There is some evidence that in the guinea pig there is a separate depressor nerve, but further work is necessary to make it conclusive.

Ending of Sensory Nerves in the Viscera with special reference to such Endings in the Bladder. (*Demonstration.*) G. Carl Huber. Gaskell, Langley and Edgeworth have described large medullated fibres in the sympathetic system. These large fibres no doubt come from the spinal and other sensory ganglia. Kölliker suggests that some of these fibres are destined to supply the Pacinian corpuscles. The author has found that the bladder of the frog is a most suitable object for studying the free ending of such sensory fibres. Large medullated fibres, which could often be traced through several small sympathetic ganglia, found in the wall of the bladder, could then be followed through their several branchings until their terminal branches found between the epithelial cells lining the bladder were reached. A single nerve fibre was found to innervate an area of about $\frac{1}{4}$ sq. mm. These endings resemble very closely the free sensory endings described for the mouth and skin.

The preparations were stained in methylene blue and fixed in a solution of ammonium picrate. They were then cleared in a mixture of glycerine and ammonium picrate, in which solution they were mounted.

Endings of Sensory and Motor Nerves in the 'Muscle Spindles' of Voluntary Muscle with demonstration of preparations. G. C. Huber (with Mrs. De Witt).

In 1860 Weismann described in embryonic striated muscle peculiar fibres with a large number of nuclei. Similar structures have been found widespread in vertebrate muscle and have been called 'muscle spindles.' Their nature has been variously regarded. They contain muscle fibres within a capsule and both motor and sensory nerves go to them.

The author has studied them in the frog, snake, cat, dog, rabbit, rat and guinea pig. The nerve fibres and endings were stained in methylene blue. They were then cleared in ammonium picrate and glycerine for teasing, or were cut into sections and double stained with alum carmine to bring out

the muscle fibres and capsule. In well-stained preparations the complexity of the nerve ending is too great for description here. It may, however, be stated that large medullated fibres (sensory), which supply these structures, divide often into several branches before reaching the spindle. Within the spindle they lose their medullary sheath and terminate in band-like structures which are wound around the muscle fibres of the spindles, usually making a few turns before ending on these fibres. Motor endings also occur on the spindle fibres, more often in the terminal portion of the spindle.

It may be suggested that, owing to the spiral arrangement of the terminations of the nerve fibres going to the spindle, the simple contraction of the muscle fibres of the spindle and their consequent enlargement might stimulate the nerve fibres.

The Protagon of the Brain. R. H. CHITTENDEN.

The author reported a series of results obtained by Mr. Frissell in a study of protagon. The total amount of phosphorus in sheep's brain by direct determination was found to be 1.664 per cent. calculated on the dry solid matter of the tissue. Of this amount 0.234 per cent. existed as protagon; 1.143 per cent. as lecithin or other like soluble bodies; and 0.213 per cent. in the form of nucleo-proteids, nuclein and inorganic salts. The results seemingly indicate that protagon contains but a small proportion of the total phosphorus of the brain and that other phosphorized organic bodies, such as the lecithins, are present, preformed in the tissue, in relatively large proportion. If we assume that all of the alcohol-soluble phosphorus of the brain, aside from the protagon, exists in the form of lecithins, we have 72 per cent. of the total phosphorus of the tissue present as lecithin, with only 15 per cent as protagon and 13–14 per cent. as nucleo-proteids and inorganic salts. Now protagon contains approximately 1 per cent. of phosphorus, while distearyl lecithin contains 4.13 per cent. of phosphorus; hence on the basis of the above figures the dry solid matter of the brain contains as much or even more lecithin than protagon.

A large number of samples of pure protagon prepared from the brains of oxen, sheep and calves showed an average content of phosphorus of 1.12 per cent, thus agreeing closely with Rappel's results. Careful study of these samples showed that, contrary to previous statements, protagon tends to undergo cleavage by long-continued heating at 45°C. in 85 per cent. alcohol, a certain amount of an alcohol-soluble (at 0° C.) body richer in phosphorus than protagon, being split off while the residual protagon obtained by recrystallization at 0° C. contained a somewhat diminished percentage of phosphorus. In other words, the stability of protagon is not quite as great in 85 per cent. alcohol as is generally stated. On the other hand, the lability of protagon is not sufficiently great to account for all of the lecithins or other soluble phosphorized principles found in fresh brain tissue. Obviously these results do not furnish any evidence as to whether the lecithin or other phosphorized bodies found in the fresh brain tissue originate directly or indirectly from the metabolism or cleavage of protagon during the life of the tissue.

An Ergometer. J. MCKEEN CATTELL.

The instrument exhibited was a dynamometer made to write on a kymograph. The maximum pressure of the thumb and forefinger or the movement of a single finger could thus be registered, and a series of movements showing fatigue could be recorded. The curves give the actual amount of work done, the height of the curves being proportional to the pressure in kilograms. The instrument was compared with Mosso's ergograph, and curves were shown in which the movements made in

lifting a weight and in extending a spring were simultaneously recorded. It was evident that the ergograph curves did not give a correct measure of fatigue, and of course gave no record when the weight was not lifted, whereas the ergometer curves measured more nearly the actual course of fatigue. The instrument is being used in the psychological laboratory of Columbia University to study fatigue and the effects of sensations and emotions on movements.

The Form of the Muscle Curve. F. S. Lee.

Under the author's direction the curve of contraction has been studied with improved apparatus in the muscles of the turtle, by Messrs. Furman and Turnure, and in the muscles of the frog, by Messrs. Beer and Gould. In the turtle the curves of different muscles differ greatly in form and time relations. The period of shortening is from two to five times that of the frog's gastrocnemius. A feature of interest is the enormous length of the period of lengthening which, *e. g.*, in the pectoralis major, may amount to fifteen seconds or three hundred times the period of the frog's gastrocnemius. With the present tendency to consider muscular relaxation an active rather than a passive phenomenon, this whole period of lengthening must be taken account of in determining the time relations of the muscular contraction. The turtle's muscles respond more readily to the make of an induction current than to the break, thus differing from those of the frog, and evidently possessing less irritability than the latter. This fact, as well as that of the very long curve of contraction, is in harmony with the sluggish movements of the animal.

In the frog the curves of different muscles thus far studied resemble one another in form and time relations much more closely. Some muscles seem to show a physiological resemblance to those of the turtle in having a prolonged period of relaxation.

The Nerve Impulse in its Relations to the Strength of the External Stimulus. C. W. Greene.

The electric current which occurs in an isolated living nerve when a nerve impulse passes along its course may now be considered as a qualitative and quantitative measure of nerve physiology. The auther has reinvestigated and extended Waller's results on this action current. Isolated nerves of frogs, turtles, cats and dogs, five to six centimeters long, were placed across stimulating and leading-off non-polarizable electrodes in a moist chamber. The faradic stimulating current was measured by an electro-dynamometer and the action current by a delicate Rowland galvanometer. (1) With equal increments of increase in stimulus above that necessary to produce a minimal deflection to a strength necessary to produce a maximal muscle effect there is a very rapid increase of action current and by equal increments. (2) With further increase in stimulus there is in the action current a continued strong increase, at first by equal but later by diminishing increments. If the results be plotted, the stimuli being placed along the abscissa and the successive action currents erected as ordinates, the curve here shows a concavity toward the abscissa. (3) With still stronger stimuli, to tenfold and more, there is only a slight further increase in action current and by equal proportional increments. This limb of the curve is important in its bearing on the nature of the nerve impulse.

Some Observations in a Case of Human Pancreatic Fistula. F. Pfaff.

The subject of the observation was a male patient in the City Hospital of Boston. Dr. H. W. Cushing had operated on the patient for an abdominal tumor. As a result of the operation a fistula formed, through which a clear watery fluid was secreted. This fluid had an alkaline reaction, digested proteids with formation of

peptone, transformed starch into sugar, and split neutral fat into fatty acid and glycerine, thus proving to be pancreatic fluid. The flow of this pancreatic secretion was observed during 48 consecutive hours. The quantities collected each hour were measured and the amount of solids and ash determined in each sample. The quantities secreted each hour were represented in a curve. This curve showed a striking resemblance to the curve representing the flow of bile, observed in a case of biliary fistula, which was reported by Dr. Pfaff at the last Christmas meeting of the Society. The total quantity of pancreatic fluid collected during 24 hours was much larger than is generally admitted for human beings. Some observations were also made on the composition of the urine and the fæces during the time that the fistula was patent.

α-Methyl-quinoline as a Constituent of the Secretion of the Anal Glands of Mephitis Mephitica. T. B. ALDRICH (with WALTER JONES).

In a paper published recently by the author it was stated that the secretion of the skunk, *Mephitis mephitica*, can be sharply separated by distillation into two approximately equal portions, and the more volatile portion was shown to be a mixture of mercaptans. From the portion of higher boiling point the authors have since succeeded in isolating a compound which can easily be identified as α-methyl-quinoline. The method of isolation is as follows: The higher boiling fraction of the original secretion is shaken several times with a 50 per cent. solution of caustic potash and then washed with water until all the alkali is removed. The product thus freed from all traces of mercaptans is extracted with several portions of very dilute hydrochloric acid, and the united acid extracts are evaporated to dryness on a water bath. The residue is taken up in a little water that has been acidified with hydrochloric acid, and is treated with a solution of zinc chloride, when a finely crystalline precipitate of the zinc chloride addition product with the base is formed, which can be purified by crystallization from water. This compound is decomposed with an excess of sodium hydroxide, and the base thus liberated is distilled with steam. The distillate is extracted with ether and the ether is allowed to evaporate. There remains a practically colorless, highly refracting oil whose physical properties accord with those of α-methyl-quinoline. Two portions of the oil were dissolved in hydrochloric acid and treated, one with platinum chloride and the other with gold chloride. In each instance a beautifully crystalline precipitate was obtained, which on complete analysis gave results which show the base to be correctly represented by the formula $C_{10}H_9N$. The composition of the double compounds are in accordance with the formulas $(C_{10}H_9N.HCl)_2 PtCl_4$ and $C_{10}H_9N.HCl.AuCl_3$.

A compound having the properties and composition of this base could only be one of the methyl-quinolines and, as only one of these isomeric substances forms an anhydrous double compound with platinum chloride, the identity of the natural base seems to be determined. This conclusion was confirmed by comparison of the base with artificially prepared α-methyl-quinoline.

Upon the afternoon of Wednesday, May 5th, in the National Theatre, the Society joined with the Association of American Physicians and the American Pediatric Society in a public discussion before the Medical Congress. The subject of the discussion was 'Internal secretions considered in their physiological, pathological and chemical aspects.' The Society was represented by two speakers: a paper by Professor W. H. Howell upon 'The General Physiology of Internal Secretions' was read by the Secretary in the absence of Professor

Howell because of illness; and Professor R. H. Chittenden read a paper upon 'Internal Secretions: Considered from a Chemico-physiological Standpoint.'

These addresses will appear in an early number of SCIENCE.

FREDERIC S. LEE,
Secretary.

COLUMBIA UNIVERSITY.

THE INTRODUCTION OF NEW TERMS IN GEOLOGY.

THE third circular sent out this year by the Committee of the International Congress of Geologists makes this statement: "*L' inondation de nouveaux termes dans le science a atteint de telles dimensions, que bientôt aucune mémoire d'homme ne sera en état de retenir toute la masse des dénominations nouvelles et que la lecture de chaque mémoire nécessitera l'emploi d'un glossaire special.*" In another paragraph new terms are spoken of as 'evidently nothing more than a useless incumbrance to the science.'

Writers on scientific subjects have often heard complaints about their 'hard words,' but these complaints have generally come from laymen; we have not before had an uprising in our own ranks. In our opinion it has come none too soon. One can scarcely read a paper on geology nowadays without feeling thankful for what is not in it, if he reaches the end without running upon some new term or some new use of an old one. Indeed, we lately saw a review of a text-book which the writer ended with the remark that not the least of the book's many virtues was the fact that the author had avoided the introduction of new terms.

We Americans have contributed our big share to this 'inundation,' and have aggravated the case by the use of Indian words and place-names that are not familiar even in this country except locally. In order to get an idea as to how far some of these words are comprehended by the common run of educated people in this country, we have inquired of many persons what idea the word 'Monadnock' conveyed to their minds. Most of them had seen the word, but knew nothing of its original meaning. One young man said he didn't know what it meant, but it was the name of a big office building in Chicago. Another one knew it only as a warship in the American Navy.

Such names are said to be used on account of their fastening in the mind certain series of facts. But where is this thing to end? We now have a bare hill protruding from the ice called a 'Nunatak,' and if one of our term-makers should visit Iceland we should soon have 'Jökul,' the name for a snow-capped peak.

A hill with one history is a 'Monadnock,' with another it is a 'Cotoctin,' and with another it is a 'Katahdin.' For as good reason we might call a synclinal valley a 'Lackawanna,' a synclinal mountain a 'Shickshinny,' a monoclinal ridge a 'Pindamonhangába,' and an anticlinal ridge a 'Jacarepaguá.' And when the bewildered European geologist doesn't know what they all mean we act the part of one of Bret Harte's characters who inquired of the man who hadn't heard of his partner:

> What? "Didn't know Flynn,
> Flynn of Virginia?
> Look 'ee here, stranger,
> Whar *hev* you been?"

New terms are often defended on the ground of their being logical. A little thought will convince any one that geology —not an exact science—can never have a logical and precise system of terms. Besides, the logic of the names of rocks, minerals and releaf features has nothing to do with the science of geology as a science, while the fixity of a nomenclature is of much more importance than any logic or special fitness of the words themselves.

Names are mere conveniences—museum

tags—that may be changed or taken away entirely without destroying the value or changing the nature of the thing. It is the thing itself that is important, not its name.

Sometimes the desire for innovations, when it can find no other changes to make, gives an old term a new meaning or substitutes a high-sounding word for a simple one. Occasionally these terms are poured fourth in such quantities that it looks as though their author had certainly invented a new science. Surely nothing can be more out of place than this cluttering up of scientific literature with verbiage that calls attention away from the subject under discussion.

Those who have done most for the spread of the knowledge of science have used the simplest language and, just so far as possible, have avoided technicalities. They have gone on the principle that what one has to say should be so said as to be understood by as many readers as possible, especially if the simplicity of the language makes clear rather than obscures the meaning.

It is earnestly to be hoped that the more sober-minded of our geologists, educational institutions and scientific societies will discourage the use of new terms when they are not absolutely necessary.

Since the above was written we have seen Dr. C. Hart Merriam's timely article in SCIENCE (May 7, 1897, p. 731) upon a 'useless and formidable,' 'disheartening and ever increasing mass of terminology.' We beg to commend it to geologists.

JOHN C. BRANNER.
STANFORD UNIVERSITY, CALIF., May 15, 1897.

CURRENT NOTES ON ANTHROPOLOGY.

SYSTEMATIC ANTHROPOLOGY.

SCHEMES, systems, plans, are of value in sciences as both indicating the directions in which investigations should be pursued and the convenient arrangements of ascertained facts. Like definitions of scientific terms, they are only provisional, suited to the present sum of knowledge, but are none the less useful for that.

In the last number of the 'Centralblatt für Anthropologie' (Heft. 2, 1897) the well-known writer, Dr. Emil Schmidt, of Leipzig, proposes the following comprehensive scheme:

Anthropology, the Study of the Human Species.

I. Natural Historical Treatment.
  A. Physical Anthropology.
    a. Man as a zoological species.
    b. The Races of Men.
      1. Descriptive treatment, Phylography.
      2. Investigation of physical principles, Phylology.
  B. Ethnic Anthropology.
    a. Descriptions of Peoples, Ethnography.
    b. Investigation of psychical principles, Ethnology.
II. Historical Anthropology or Prehistory; investigation of the earlier and lower stages of humanity.

The neologisms, phylology and phylography he introduces from *Φύλη*, which he explains as the physical, while *ἔθνος* is the social and psychical group. His objections to previous schemes are also stated.

ABORIGINAL CULTIVATION OF MAIZE.

AGRICULTURE in primitive America is the more important as a cultural stage owing to the total absence of the pastoral life. Maize was usually the principal cultivated plant, and for that reason a study by Mr. Gardner P. Stickney on its use by the Wisconsin Indians (Parkman Club Publications, No. 13) merits especial attention. It is the result of close reading of the old authors and of local investigation. His conclusions are that the Wisconsin Indians raised it in large quantities, enough for their own wants, and an excess, which they used in trade; while even those tribes in the area of the State who dwelt so far north that it was an uncertain crop gave considerable attention to it, and sometimes raised it in abundant fields. These tribes belonged

to the widespread Dakotan and Algonquian stocks, and thus we find the aborigines carrying the culture of this noted tropical plant up to the northernmost limits of its possible propagation.

THE GROOVED STONE AXE.

THE statement is occasionally made in lectures and articles on the American aboriginal stone industry that the grooved and polished axe, so common in our collections, is an artefact peculiar to our continent.

It is true that in its special shape it is rare in European collections. They have the grooved maul or pounder, but not often the polished axe with the groove running round near the butt and with a sharpened edge. A fine example, however, from southern Italy, is described and figured by Dr. Schoetensack in the 'Zeitschrift für Ethnologie' (Heft I., p. 9, 1897). That it was of local origin was proved by the kind of stone of which it was made. He refers to its similarity to American specimens, and quotes other instances where they have been found in the Old World. This is but another example where the artificial products of early man reveal striking similarities in all continents.

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UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

IN the last proceedings of the Chemical Society (London), A. E. Munby describes a Bunsen burner for acetylene which has proved very satisfactory in his hands. The tube is only five millimeters in diameter, or a slightly wider tube may be used, provided the mouth be curved inwards. With a larger opening there is a tendency for the flame to strike down. The gas jet is very small, delivering only one foot of acetylene per hour, under six inches of water pressure. The air holes must be large, and with sufficient air a non-luminous flame is given. The heating effect of the acetylene gas is large, and seems to be about twice that of coal gas. Mr. Munby suggests that the use of such a convenient source of heat should do much to stimulate research in country places, where, coal gas not being procurable, heretofore no good source of heat was available.

IN the same number Heycock and Neville, who have done so much to further our knowledge of alloys, describe the study of the sodium-gold alloys with the X-rays. Sodium is much more transparent to the rays than gold, and X-ray photographs of thin sections of the alloy show its crystalline structure very clearly. The authors point out that other alloys may be similarly studied, and are at present engaged of those of aluminum. It is possible that by this method our knowledge of alloys may be materially extended.

IN a graduating thesis at Washington and Lee University, Mr. J. R. K. Cowan takes up the question of the presence of tin in canned goods, and his results confirm those of previous investigators along this line. He finds tin present in every can examined, including tomatoes, peaches, apricots and sweet potatoes, in quantities of from 60 to 150 miligrams per kilo. Granting that this tin is present in a form which can be acted upon in the human system, and considering the large consumption of canned goods, it seems to follow that tin is less toxic than has been supposed and that it cannot be a cumulative poison. The maximum dose of tin is given as half a grain of chlorid, but the amount of tin corresponding to this might often be taken into the system during a single meal. Very few cases of supposed tin poisoning from eating canned goods have been reported, and it is probable there is little danger from this source. In no instance did Mr. Cowan detect the presence of lead.

IN the last *Chemical News* Delafontaine gives an account of further researches on the more deeply colored of the rare earths. This recent work was with Fergusonite from Bluffton, Texas, and he confirms the existence of the element philippium, discovered by him nearly twenty years ago, but whose independent existence as an element has been questioned by Roscoe and other observers. It is more closely related to terbium and cesium than to other rare earths, but is distinguished from both by marked reactions and the deep color of its oxid and subnitrate.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE officers of sections at the Toronto meeting have now been selected, although others may subsequently be added to the list. All the officers expect to attend the meeting and American men of science who are able to be present will thus have the privilege of meeting many of the leaders in science of Great Britain. The officers are as follows:

A.—MATHEMATICAL AND PHYSICAL SCIENCE.

President, Prof. A. R. Forsyth, M.A., D.Sc., F.R.S.
Vice-Presidents, R. T. Glazebrook, M.A., F.R.S.; Prof. A. Johnson. M.A., LLD.; Prof. O. J. Lodge, D.Sc., F.R.S.
Secretaries, J. C. Glashan; Prof. W. H. Heaton, M.A. (*Recorder*); J. L. Howard, D.Sc.; Prof. J. G. McGregor, D.Sc., F.R.S.E.

B.—CHEMISTRY.

President, Prof. W. Ramsay, Ph.D., F.R.S.
Vice-Presidents, Prof. H. B. Dixon, M.A., F.R.S.; W. R. Dunstan, M.A., F.R.S.; Prof. B. J. Harrington, Ph.D., F.G.S.; Prof. W. H. Pike, M.A., Ph.D.; Prof. W. C. Roberts-Austen, C.B., F.R.S.; T. E. Thorpe, Ph.D., F.R.S.
Secretaries. Prof. W. H. Ellis, M.A., M.B.; Arthur Harden, Ph.D., M.Sc. (*Recorder*); C. H. Kohn, Ph.D.; Prof. R. F. Ruttan.

C.—GEOLOGY.

President, Dr. G. M. Dawson, C.M.G., F.R.S., F.G.S.
Vice-Presidents, Prof. C. Le Neve Foster, D.Sc., F.G.S., F.R.S.; Dr. H. Woodward, F.R.S., F.G.S.
Secretaries, Prof. A. P. Coleman, Ph.D.; G. W. Lamplugh, F.G.S.; Prof. H. A. Miers, F.R.S., F.G.S. (*Recorder*).

D.—ZOOLOGY.

President, Prof. L. C. Miall, F.R.S., F.L.S.
Vice-Presidents, Prof. W. A. Herdman, F.R.S.; Prof. R. Meldola, F.R.S.; Prof. E. B. Poulton, F.R.S.; Prof. R. Ramsay Wright, M.A., B.Sc.
Secretaries, W. Garstang, M.A., F.Z.S., (*Recorder*); W. E. Hoyle, M.A.; Prof. E. E. Prince, B.A.

E.—GEOGRAPHY.

President, J. Scott Keltie, LL.D., Sec. R.G.S.
Vice-Presidents, President N. Burwash, LL.D.; Major L. Darwin, Hon. Sec. R.G.S.; E. G. Ravenstein, F.R.G.S.
Secretaries, Col. F. Bailey, Sec. R.S.G.S.; Capt. E. Deville, H. R. Mill, D.Sc., F.R.G.S. (*Recorder*); J. B. Tyrrell, M.A.

F.—ECONOMIC SCIENCE AND STATISTICS.

President, Prof. E. C. K. Gonner, M.A., F.S.S.
Vice-Presidents, Prof. W. Clark, M.A., LL. D.; Sir C. W. Fremantle, K.C.B.; Prof. J. Mavor.
Secretaries, E. Cannan, M.A., F.S.S.; H. Higgs, LL.B., F.S.S. (*Recorder*); Prof. Adam Shortt, M.A.

G.—MECHANICAL SCIENCE.

President.—G. F. Deacon, M. Inst.C.E.
Vice-Presidents, Prof. W. E. Ayrton, F.R.S.; Prof. H. T. Bovey, M.A.; Sir C. Douglas Fox, M. Inst. C.E.; Prof. John Galbraith, M.A.
Secretaries, Prof. T. Hudson Beare, F.R.S.E. (*Recorder*); Prof. Callendar; Prof. Dupuis; W. A. Price.

H.—ANTHROPOLOGY.

President, Prof. Sir W. Turner, M.B., LL.D., F.R.S.
Vice-Presidents, E. W. Brabrook, Pres. Anth. Inst.; G. L. Gomme, F.S.A.; R. Munro, M.D., F.R.S.E.
Secretaries, A. C. Chamberlain, Ph.D.; H. O. Forbes, LL.D.; J. L. Myres, M. A., F.S.A. (*Recorder*).

I.—PHYSIOLOGY.

President, Prof. Michael Foster, M.A., LL.D., Sec. R.S.
Vice-Presidents, W. H. Gaskell, M.D., F.R.S.; Prof. A. B. Macallum, M.B., Ph.D.; Prof. A. D. Waller, M.D., F.R.S.
Secretaries, Prof. Rubert Boyce, M.A. (*Recorder*); A Kirchmann, Ph.D.; Prof. C. S. Sherrington, M.D.. F.R.S.; Dr. L. E. Shore.

K.—BOTANY.

President, Prof. H. Marshall Ward, D.Sc., F.R.S., F.L.S.

Vice-Presidents, Prof. F. O. Bower, D.Sc., F.R.S., Prof. D. P. Penhallow.

Secretaries, Prof. J. B. Farmer, M.A., F.L.S.; E. C. Jeffrey, M.A.; A. C. Seward, M.A., F.G.S.; Prof. F. F. E. Weiss, B.Sc., F.L.S. (*Recorder*).

THE BRITISH REPORT ON THE BEHRING SEA SEAL FISHERIES.

A Parliamentary paper was issued on May 22d containing Professor D'Arcy Thompson's report on his mission to Behring Sea. The report concludes as follows:

In the foregoing account I have merely set forth my observations of the herd and its past history in so far as both together show that the alarming statements to which utterance has been given in recent years, the accounts of the herd's immense decrease and the prophecies of its approaching extinction, are overdrawn and untenable. But it is my duty to state to your lordship that there is still abundant need for care and for prudent measuras of conservation in the interests of all. A birth-rate which we estimate at 143,000 per annum is not great in comparison with the drain upon the stock. From one cause or another a loss of over 20,000 is experienced among the pups ere they emigrate to sea; and though the dangers they there encounter are unknown to us, we may take it for certain that the risks they run are great and the loss they endure considerable. When to the measured loss in infancy and to the unmeasured loss in youth and age we add the toll taken on the islands and the toll taken in the sea, it is not difficult to believe that the margin of safety is a narrow one, if it be not already in some measure overstepped. We may hope for a perpetuation of the present numbers; we cannot count upon an increase. And it is my earnest hope that a recognition of mutual interests and a regard for the common advantage may suggest measures of prudence which shall keep the pursuit and slaughter of the animal within due and definite bounds.

The London *Times*, which is supposed to reflect official opinion, publishes a column and a-half of editorial comment, ending as follows:

Our own commissioner is entirely of the same opinion [referring to Dr. Jordan's recommendation of further scientific investigation], and is much more cautious in the conclusions to which he has come. In these circumstances it seems only common sense to collect further evidence before we proceed to revise the present regulations. We are ready to admit that they may not be the best which it is possible to devise in the interests both of pelagic and of shore sealers. But we say that this has not yet been proved, and that until it is proved we are under no obligation to vary the present rules. The suggestion that we should surrender the exercise of a lucrative industry which is admittedly lawful, without receiving an equivalent, merely in order to increase the actual and prospective profits of our rivals, is not admissible in any event. What would the United States answer to a similar proposal in regard to the fishery rights they possess on the 'American Shore' in New Foundland? They would answer, 'It is not business.'

GENERAL.

Professor W. Crookes will be nominated as President of the British Association for the Bristol meeting of 1898.

Professor Felix Klein has been elected a corresponding member of the Paris Academy of Sciences in the room of the late Professor Sylvester.

Mr. Robert Douglas, known for his work in arboriculture and forestry, died on June 1st at Waukegan, Ill. He was born in England in 1813. Mr. Charles Benjamin Brush, formerly professor of civil engineering in New York University and a well known civil engineer, died in New York on June 3d, aged forty-nine years. The death is also announced of Sir Augustus Wollaston Franks, F.R.S., the archæologist, at the age of seventy-one years; of Dr. G. Ossowski, the geologist, at Tomsk, on April 16th; of Dr. Edwin Freiherr v. Sommaruga, assistant professor of chemistry at the University of Vienna, on May 10th, at the age of fifty-three years; and of A. L. O. Descloizemitt, the mineralogist member of the Paris Academy, on May 8th, at the age of seventy-nine years.

The Rede lecturer of Cambridge University, Professor A. W. Rücker, was announced to deliver his lecture on June 9th, the subject being 'Recent Researches in Terrestrial Magnetism.'

We learn from *Nature* that at the anniversary meeting of the Linnæan Society of London, held on May 24th, the gold medal of the Society was awarded to Dr. Jacob Georg Agardh, emeritus professor of botany in the University of Lund, known for his researches on *Algæ*.

An expedition from the biological department of the University of New York, under the direction of Professor Charles L. Bristol, sailed from New York for Bermuda, on June 3d. General Russell Hastings has offered the University land

near Hamilton, Bermuda, for the erection of a permanent biological station. Professor Bristol is accompanied by Dr. Tarleton H. Bean, director of the New York Aquarium, who will make collections for the Aquarium; by Walter Rankin, of Princeton University; by Mr W. H. Everett, instructor, and by several students of New York University.

DR. J. E. HUMPHREY, lecturer in botany in Johns Hopkins University, has left Baltimore for Jamaica with a party of students which will probably be joined later by Professor W. K. Brooks. A house for a marine biological laboratory has been secured at Port Antonio, on the north side of the Island. In other years the laboratory has been located at Port Henderson, on the south side, but it is thought that a change may offer new materials and opportunities.

NEWS from Adelaide indicates that Charles F. Wells and J. W. Jones were killed by natives while exploring central Australia. The expedition of five persons, led by Mr. A. L. Wells, was fitted out by Mr. Alfred L. Calvert and crossed the inland desert of Australia, starting from Cue, West Australia, in June of last year.

AN expedition fitted out by the Canadian government left Halifax on June 2d to investigate the practicability of the Hudson Bay route to Europe, especially for the shipment of grain from the Northwest.

THE New York *Evening Post* has printed an account of the discoveries of Dr. Sven Hedin, a Norwegian, who for the past three years has been exploring the least known regions of Persia, Russian Turkestan and the Pamirs. Among other interesting discoveries he is said to have found ruins of a city buried in the sands, containing valuable manuscripts.

IT is reported that Captain Sverdrup will go with the Fram to Smith's Sound next year, spend the winter there, and then attempt a sledge journey northward.

LIEUTENANT PEARY will be accompanied this summer by a party under the direction of Mr. Russell W. Porter, who will make explorations in Baffin Land. A party from Colby University will also go north with Lieutenant Peary.

THE New York Aquarium was visited by no less than 21,456 persons on Sunday, June 6th.

IT is proposed to enlarge the Missouri Botanical Garden, so that the land belonging to the Shaw estate, over eighty acres in extent, will be gradually added to it. It is planned to drain and grade twenty-one acres during the present season.

THE will of Mrs. Sarah Withers, of Bloomington, Ind., bequeaths $40,000 to found a library in Nicholasville, Ky., where she was born. Some years ago she established the Withers library in Bloomington.

MR. F. J. WALZ has been sent by the United States Weather Bureau to take charge of the Maryland State Weather Service, which is conducted at the Johns Hopkins University, by the cooperation of the government, the University, the State and the Maryland Agricultural College.

THE last meeting for the present season of the American Mathematical Society was held at Columbia University on May 29th. Papers were presented by Professor F. Morley, of Haverford College; Dr. Emory McClintock, of New York, and Dr. E. O. Lovett, of Johns Hopkins University. The regular meeting of the Society will be held hereafter in New York on the last Saturday in October, December, February and April, each meeting to consist of a morning and afternoon session, which will allow as much time as the present monthly meetings. The Chicago Section will hold meetings in December and April of each year. The Society holds its summer meeting at Toronto on August 16th and 17th.

THE American Medical Association held its semi-centennial celebration at Philadelphia on June 2d, 3d and 4th. The address by the President, Dr. Nicholas Senn, reviewed the work of the Association, its past, its present and its future. Dr. Austin Flint, of New York, gave the address in medicine, and Dr. W. W. Keene, of Philadelphia, the address in surgery. The Association was also addressed by the President of the United States, the Governor of Pennsylvania and the Mayor of Philadelphia. It was reported that only about $4,000 had been subscribed to the monument to

Benjamin Rush, to be erected at Washington, but the amount was much increased by subscriptions at the meeting. The Association will next meet at Denver, under the Presidency of Surgeon-General George M. Sternberg.

A CONFERENCE of the members of the Institution of Civil Engineers was held in London this year under conditions convenient to many who are precluded from attending the weekly meetings during the session, and serviceable to all by the discussion of a wider range of subjects than can be dealt with on ordinary occasions. The business of the conference differed from the ordinary proceedings of the institution, papers descriptive of works executed giving place to brief statements concerning important debatable matters in engineering science and practice, introduced with a view to eliciting discussion on the questions raised. The conference was held on May 25, 26 and 27, the morning of each day (from 10:30 to 1:30) being devoted to the consideration of the statements referred to, and visits of inspection to engineering works being made in the afternoon. The work of the conference was carried out under the direction of the Council, with the assistance of seven sectional committees. The sections were: Railways, with Sir Benjamin Baker as chairman; harbors, docks and canals, Mr. Harrison Hayter, chairman; machinery and transmission of power, Sir Frederick Bramwell, chairman; mining and metallurgy, Mr. T. Forster Brown, chairman; shipbuilding, Sir William H. White, chairman; waterworks, sewerage and gasworks, Mr. Mansergh, chairman, and applications of electricity, Mr. W. H. Preece, chairman.

A *Revue Philanthropique* will hereafter be published in Paris by Masson et Cie, edited by M. Paul Strauss. The *Revue* will be published monthly, each number containing 160 large pages. The first number contains articles of considerable scientific interest.

THERE has been established in Italy a 'Società Positivista,' whose object it is to demonstrate the importance of science for modern life. The society has established a bi-monthly journal entitled *Il Pensiero Moderno*, published by the Society at Via Collegio Romano, 26, and edited by Professor G. Sergi. Professor Sergi contributes an introduction and an article to the first number. Professor Sergi is also one of the editors of a new *Revista Italiana di Sociologia*, which takes the place of the *Revista di Sociologia*, formerly edited by Professors Sergi and Tangorra.

THE first number of a monthly *American X-ray Journal* has been issued from St. Louis, being edited and published by Dr. Heber Roberts. It contains a portrait of Dr. Röntgen and a number of photographs especially intended for the medical profession.

THE report of the Medical Superintendent to the London Metropolitan Asylums Board on the use of anti-toxin and the treatment of diptheria during the year 1896 confirms the favorable results reached the previous year. The percentage of mortality being reduced from 29.6 in 1894 to 20.8 in 1896.

IT has been announced in the Legislative Assembly of Cape Colony that the shooting of cattle had been stopped as being a useless attempt to maintain a clean belt. It was added that it was impossible to prevent the rinderpest from reaching Cape Colony.

THE International Fisheries Exhibition at Bergen, to which we have already referred, will be opened on May 16, 1898. It will include the following groups: 1. Fish products. 2. Fishing apparatus. 3. Vessels employed in the catch and their equipment. 4. Preservatives. 5. Lodging ships, lodging houses and station huts. 6. Tank and other transport vessels. 7. Models and drawings of warehouses, salting establishments, smoke houses, ice houses and other cold rooms. 8. Machines, tools and apparatus. 9. Fish culture. 10. Pleasure fisheries. 11. Facts about the fisheries and their development. 12. The life-saving service.

UNIVERSITY AND EDUCATIONAL NEWS.

MCGILL UNIVERSITY, Montreal, receives $100,000 by the will of the late J. H. R. Molson, who was senior governor of the University.

THE REV. FATHER MACKAY has given $5,000 to the Catholic University of America for the foundation of a scholarship.

THE general board of studies of Cambridge University recommend that a University lectureship in physiological and experimental psychology, connected with the special board for biology and geology, be established for the term of five years from October next, and that the stipend of the lecturer be £50 a year.

PROFESSOR H. K. WOLFE has resigned the chair of psychology in the University of Nebraska. Dr. W. B. Pillsbury, now instructor in psychology in Cornell University, has accepted a similar position in the University of Michigan. Mr. F. C. S. Schiller, instructor in logic in Cornell University, will return to Oxford, having been elected fellow and tutor in Corpus Christi College. It is understood that Dr. C. E. Seashore, now assistant in Yale University, will be appointed assistant in psychology in the University of Iowa, and Dr. J. H. Leuba, lately fellow at Clark University, to a position in psychology in Clark University. Mr. S. I. Franz has been elected assistant in psychology in Columbia University.

PROFESSOR WILLIAM S. FRANKLIN, of Iowa University, has been elected to the chair of physics and electrical engineering at Lehigh University, filling the place vacant by the resignation of Professor Harding. Dr. John Marshall has been appointed to the chair of chemistry in the medical department of the University of Pennsylvania, vacant through the death of Professor Theodore G. Wormley.

MISS MARY E. PENNINGTON was appointed Thomas A. Scott fellow in hygiene in the University of Pennsylvania. Miss Bertha Stoneman, now at Cornell University, has been appointed to the chair of botany in the Huguenot College for Women in Cape Colony.

REV. R. E. JONES, of All Angels' Church, New York city, has been nominated for the Presidency of Hobart College, Geneva, N. Y.

PROFESSOR J. L. PREVOST has been elected professor of physiology in the University of Geneva. Dr. P. Francotte has been appointed professor of embryology and Dr. P. Stroobant professor of astronomy in the University of Brussels. Dr. J. J. Zumstein has been promoted to a professorship of anatomy in the University of Marburg.

DISCUSSION AND CORRESPONDENCE.

THE POTTER'S WHEEL IN ANCIENT AMERICA.

THE paragraph referring to American Ceramics, by Dr. D. G. Brinton, in SCIENCE, for May 21, 1897, page 797, containing the categorical statement that 'the device of the potter's wheel was (anciently) unknown in either North or South America,' should be noted as inadequate. Under the present knowledge of the subject, while referring, as a noteworthy substitute for the wheel, to a clay dish twisted by the Chillian Indians (Araucanians), so as to mould the clay ball resting in it (described in *Globus*, February 20, 1897), it would have been well to mention a similar device from the Southwest or Mexico, which, according to Professor Putnam, had been in the possession of the Peabody Museum at Cambridge, Mass., for sometime previously.

More uninstructive is it to ignore the *Kabal*, of Yucatan, a disc of wood caused to turn on a slippery board by the bare feet of the (present) Maya potter, while the clay sticking to the disc and revolving with it is thus made to mould itself symmetrically against the stationary fingers of the worker. This very noteworthy device, a primitive potter's wheel in the full sense, was observed and fully explained by the Corwith Expedition of the University of Pennsylvania to Yucatan in 1895. I illustrated it in 'Hill Caves of Yucatan' (Lippincott, Philadelphia, 1896, page 163), having previously described it to archæologists, in the *American Naturalist*, for May, 1895. A correspondence with Dr. Brinton upon the significance of the Maya word *Kabal* resulted in his failure to find the word in the Spanish dictionary of the Maya language, published at the monastery of Motul in 1576, upon which he argued, inconsequently I thought, that the device had been brought to Yucatan by Spaniards. On the other hand, the late Bishop of Yucatan and, I think, Captain Theobert Maler believed it to be indigenous, and I have as yet learned of no discovery of the *Kabal* device in Spain or among the Moors in Africa. Under these circumstances, whether final investigation shall prove the *Kabal* to have been of European or American origin, the general references above noted to the potter's craft in

the New World, omitting mention of this long unnoticed instrument (not yet described in duplicate, to my knowledge, anywhere else in the world), are unsatisfactory. The specimens attesting the interesting process, in the possession of the museum of the University of Pennsylvania, since 1895, cannot be ignored.

H. C. Mercer.

Indian House, May 23, 1897.

THE SIGNIFICANCE OF INTERNAL SECRETION.

The communication on the above subject published in Science for April 30th, by Mr. Albert Mathews, seems to me not only of interest, but of importance, because it indicates in a comprehensive way some of the directions in which our thoughts may move just now to advantage. Views not wholly unlike these of Mr. Mathews are hinted at in my 'Animal Physiology' (1889); but it has been especially in lectures to my most advanced class in physiology that, for ten years, I have been accustomed to insist on the bearing of the function of one part on that of another—a subject generally neglected in the books—and also the relation of the development of one tissue or organ as determined by another. Necessarily it was impossible, till more recent discoveries had been made, to indicate many of the ways in which this is brought about, and even yet we can do so but vaguely.

It was very natural, therefore, for me to hasten to read Mr. Mathews' communication to my class and to enforce its teaching by comparison with similar expressions of opinion in a paper entitled 'Experimental Cachexia Strumipriva,' published in the *Canadian Practitioner* in October (?) 1895. I venture to think that Mr. Mathews will find in this paper views as broad as his own, if not more so. To quote a single sentence: "No cell is so small, so distant from others, but that in some way it makes itself felt, and this is to me the most important lesson of all this recent development in physiology and medicine growing out of the study of the total or partial extirpation of organs, of transplantation, of feeding of glands, etc." The extension of the principle of the influence of the internal secretion to plants is admirable, in my opinion, and in this I am inclined to believe that Mr. Mathews is entirely original. However, while Mr. Mathews' views are broad they are apt, if taken alone, to lead to narrowness by their very exclusiveness. When he seeks to explain the co-ordinated life of plants in this way does he also remember the *protoplasmic continuum*, and when he would explain by internal secretion the co-ordination in movement, say, of one cell with another in simple invertebrates does he bear in mind the possibility of explanation through *molecular impact*? Life implies ceaseless molecular movement. Just now we are witnessing, in the medical world, the most remarkable development of chemical conceptions to explain pathological conditions that has yet taken place, but, as usual, with a narrowness that is evidence of the evil effects as well as the advantages of specialization. The doctrine of 'pangens' has always seemed to me a crude and unnecessary hypothesis, and I cannot believe that internal secretion *alone* will supply an adequate substitute, though it will assist to a better understanding of certain results in detail.

Nearly ten years ago I put forward a view in a paper entitled 'A Physiological Basis for an Improved Cardiac Pathology' (*Medical Record*, October 22, 1887), which, so far as I know, was then set forth for the first time in print, though it had been earlier taught in my lectures. This conception was more fully elaborated in 'The Influence of the Nervous System on Cell Life.' (*New York Medical Journal*, December 22, 1888.)

I endeavored to show that we were justified in holding that the nervous system exercised a *constant influence* over all cells, tissues and organs, either directly or indirectly, in every animal provided with such a system, this influence being the more important the higher the animal in the scale of existence. This theory of the constant influence of the nervous system over metabolism, etc., has, so far as I am aware, not been recognized or, at all events, taught by anyone except myself, till it was prominently brought forward last October by Professor M. Foster, the well-known physiologist, in his admirable Huxley lecture. It has since been publicly espoused by the distinguished neurologist Gowers, and will, I have no doubt, shortly receive the recognition which I have long felt it deserved.

To me this is a far more important single concept than any other to explain co-ordination of all kinds, even the continuance of the healthy life of cells in higher animals, unless it be that of the influence of protoplasm on protoplasm, *per se*, and directly. Nevertheless, this doctrine of the influence of one cell on another, through chemical agency, which the theory of the constant effect of the nervous system renders clearer for all higher animals, is one that is also indispensable and which we are now beginning to understand in more detail. The main purpose of this communication is to put forward as broad a basis as possible for conceptions of the nature of living things, for the exact demonstration of which in a way to satisfy a rigid logic we must still wait, it may be long, but which we cannot afford, in the meantime, to ignore without making many errors and unduly restricting the field of view.

WESLEY MILLS.

McGILL UNIVERSITY,
MONTREAL, May 13, 1897.

HIGHHOLE COURTSHIP.

SOME mornings since I observed two highholes on the same branch evidently in courtship. The male, as I took it, would give a few clucks, and rapidly bob its head up and down four or five times describing about a quarter of a circle, and the female then responded with the few clucks and corresponding motions. This was repeated at short intervals, and they flew to another tree, and continued this rather comical performance. Mr. Burroughs, in describing this courtship of the highhole, speaks of the female as 'unmoved,' which, however, was plainly not so in this case. As the meaning of the head bobbing I would suggest that the motion, being much the same as when pecking at a tree or in the turf, may signify the offering of food. The male says, "Come with me and I will find you lots of fat grubs," and the female assents by the same acts and signifies mutuality. The whole is in the same line of sentiment and action as that of the young man who offers his best girl ice cream and soda water. I may also mention that I have often noticed this spring what I supposed to be the male blue jay approach his mate with a cluck and transfer to her bill some article of food, the whole affair appearing to be gallantry. It may even be that the kiss is a survival of lip-to-lip feeding.

As to the pugnacity of birds in early spring I may mention that some seasons since I observed a cock robin fight for some hours his own reflection in a cellar window. This season a mirror was placed upon a wren's box which had been usurped by a pair of English sparrows. The female fought her reflection most furiously, but the male showed more intelligence, investigated carefully, and would retire around the tree and peer out to see if the supposed bird would move toward the nest. At nightfall he took his place before the mirror, as if on guard. A carefully conducted series of experiments with mirrors upon birds and other animals would, by providing the new environment, be of great value in testing intelligence.

HIRAM M. STANLEY.

LAKE FOREST, ILL., May 5, 1897.

A QUESTION OF CLASSIFICATION.

TO THE EDITOR OF SCIENCE: In your issue of December 18, 1896, pp. 918–922, in a communication by myself entitled 'A Question of Classification,' through a typographical error I am made to say that "all other students place the Dakota formation in the middle of our American Upper Cretaceous." The word 'Upper' should have been omitted from this sentence, as it was my intention to say that "all other students place the Dakota formation in the middle of our American Cretaceous and at the base only of the upper of the two great series into which the Cretaceous of this country is divided."

ROBT. T. HILL.

SCIENTIFIC LITERATURE.

The Materials of Construction. A Treatise for Engineers on the Strength of Engineering Materials. By J. B. JOHNSON, Professor of Civil Engineering in Washington University, St. Louis, Mo. New York, John Wiley & Sons. 1897. 8vo. Cloth. Pp. xv+787, with 9 plates. Price $6.00.

This work is divided into four parts, the first treating of the mechanics of the subject, the second of general properties of materials, the third of methods of testing, and the fourth of results of tests. The number of pages in these

several parts is 86, 215, 167 and 254, the remaining 65 pages being devoted to an appendix and index. Although mainly designed for engineers, it will be useful to physicists and to all who have to do with the mechanic arts, for a large part of the information that it gives can be found in no other book. The task of the author in sifting and discussing the vast number of tests on record was a difficult one, but it has been performed with skill and success.

Part I is somewhat disappointing in that it is, in the main, occupied with elementary matter regarding bars and beams which is found in all text-books on the resistance of materials. In an advanced work of this kind the engineer or physicist would naturally expect to find the mathematical theory of elasticity developed to a point in advance of that taught in technical schools, and especially to see the theory of true internal stress in beams set forth. A valuable discussion regarding the elastic limit is here given, and the results of very recent theoretic investigations of combined concrete and iron beams are presented.

Part II, although perhaps giving a fuller account of the manufacture and properties of materials than other general works on construction, has not been prepared with the best care and discrimination. For instance, the blast furnace is not mentioned, although 14 pages on the manufacture of cast iron is quoted from a British book on metallurgy. The chapter on timber, which fills 97 pages, is a reprint from a bulletin of the United States Forestry Bureau, and much of this might have been well omitted altogether, while the remainder should have been properly digested and condensed. Steel, cement and paving brick are discussed, however, in a very clear and concise manner.

Part III presents a more complete account of testing machines and methods of testing than can be found elsewhere in book form. The classification and discussions are here most excellent, and the presentation of conclusions of the European commissions on the question of standard specimens and methods is very complete. Static tests of tension and flexure naturally receive the greatest share of attention. Impact tests, with the exception of the cold-bend and drifting methods, seem inadequately treated in view of their growing use and importance; for instance, the flexural test of steel rails by a falling ram, where deflections and the elongations on the tensile side are measured, has long been used in Europe and during the past five years has been adopted by some of our leading railroads, and hence should have received at least brief notice.

Part IV gives an admirable digest of the results of experiments on materials. A most excellent feature, and one which indeed runs throughout the entire book, is the presentation of results by means of diagrams. These set forth the relations between the different properties of materials far more clearly than columns of figures can do and enable the reader to make comparisons which otherwise would be difficult or impossible for him to undertake. The tests which are discussed are, in the main, those precise and comprehensive ones made on metals during the past twenty years by Bauschinger, Tetmajer, the French commission, and by Howard at the Watertown arsenal, and those by the author on timber. Lack of space forbids a mention of the conclusions and results here recorded, but it should be said that the care exercised in selecting the data and the admirable method of presentation is alone sufficient to render the book an authoritative one.

The proper definition of the term 'elastic limit' has long been a puzzling question. While generally defined as the limit at which Hooke's law of proportionality of stress to deformation fails to hold good, it has also been explained to be characterized by the beginning of the permanent set, while in commercial tests the so-called yield point, where a sudden molecular change occurs, is generally regarded as the elastic limit. The author discusses these definitions at length, and proposes that the term 'apparent elastic limit' be used to indicate that point where the rate of elongation is fifty per cent. greater than the rate at the beginning of the elongation. This definition enables the elastic limit to be readily marked on a stress diagram, and for ductile materials it appears to locate a characteristic point which lies higher than the limit of elastic proportionality and lower than the yield point. The new definition, although defective in not referring

to a definite physical phenomenon, has some practical advantages, and it will doubtless receive extended notice and discussion by engineers. An authoritative definition of elastic limit will probably be established in time by the international association recently established for the study and unification of methods of testing.

The author lays much stress upon the method of judging the quality of a material by means of the work required to rupture it, or by its resilience, as Thomas Young called it in 1803. The diagram of a tensile test enables this work to be computed, and undoubtedly too great attention has heretofore been paid to the ultimate elongation and too little to the ultimate resilience. The elongation depends upon the form and length of the specimen and is far from being an absolute measure of the ductility; moreover that part of it which occurs after the maximum strength is reached is of doubtful value in estimating the work of rupture. It is for these reasons that percentage of reduction of area is extensively used in commercial tests, it being found to be nearly independent of the length of the specimen and hence a better index of ductility. In this direction of investigation great advances are to be expected, and the development of impact tests now in progress really results from the desire for a better determination of the ultimate resilience than the static stress diagrams can give. If all tests of metals except one were to be abandoned, the simple test of bending a cold bar by blows of a hammer would, by an overwhelming majority of votes, be the one to be retained; further, if this cold-bend test be made by a single blow, and if the changes of length on the tensile and compressive order be measured, a determination of both resilience and ductility is obtained, which, though not an absolute one, is probably as valuable as that given by the common static tension test. For these reasons it is thought that the author has somewhat overestimated the value of the ultimate elongation as determined on testing machines, and that reliance upon it as an absolute measure of ductility is generally too high.

The space devoted to the different materials is about as follows: 124 pages on timber, 43 on brick and stone, 77 on cement and mortar, 43 on cast iron, 24 on wrought iron, 87 on steel, and 18 on alloys. A timely chapter on the magnetic testing of iron and steel, by W. A. Layman, concludes the book. There are over 600 illustrations, of which about one-half are the valuable graphic representations and comparisons. From the extended experience of the author in laboratory work, and from his record as a writer and investigator, it was to have been expected that this book would be an excellent one. It has, however, more than realized the expectations in its Parts III and IV, for here are presented such careful and comprehensive analyses of modern methods and results that the book must at once take high rank as one of the standard authorities on the materials of engineering.

MANSFIELD MERRIMAN.
LEHIGH UNIVERSITY, June 1, 1897.

Experimental Morphology. Part I. By. Dr. C. B. DAVENPORT. The Macmillan Company. 1897.

The broadening of the biological horizon in recent years has necessitated an ever-increasing specialization on the part of investigators in that department of science. The territory now open to study is so extensive that it is beyond the powers of any individual to examine all parts of it in detail, and, consequently, each must choose for himself a portion of greater or less extent with which he may expect to become tolerably familiar. And yet it is impossible to reap the full benefits of results so obtained unless they can be correlated with what is being accomplished in adjacent fields, and, that his work may approach the ideal condition of being *totus teres atque rotundus*, the investigator of to-day must look to his neighbors to supply him from time to time with statements of what they have accomplished. Dr. Davenport's work on Experimental Morphology aims to be a statement of this kind, its object being to review what has been accomplished in the study of the extrinsic forces which determine the course of the development of organisms. The work, as projected, is to consist of four parts, of which the first, now before us, treats of the action of external forces, chemical and physical, on living protoplasm in general, while

the other three will consider their influence on growth, cell-division and differentiation.

If the first part is to be regarded as an earnest of what is to come, all biologists will look forward with interest to the completion of the work. The present part gives in successive chapters admirable and thorough accounts of the various observations and experiments on the action on living protoplasm of chemical agents, moisture, density, molar agents, gravity, electricity, light and heat, and concludes with an all too brief chapter discussing the light thrown by these observations on the structure of protoplasm, the conditions which limit metabolism, the dependence of protoplasmic movement on external stimuli and on metabolism and on the determination of the direction of locomotion. The action of each force is considered under several headings; light, for example, being considered as to its chemical action, its effect on the general functions of the organism and its action in controlling the locomotion (phototaxis); and the text is illustrated by numerous well-chosen figures as well as by several tables of which there may be especially mentioned No. XVIII., which gives the nature of the response to light of the various forms which have been experimented upon in this connection; No. XIX., which gives the ultramaximum temperature for numerous organisms; No. XX., which similarly gives the ultraminimal temperatures, and No. XXI., which is a list of species found in Hot Springs with the conditions under which they occur. The author's judgment in the treatment of his subject is excellent, as he has confined himself for the most part to a judicious statement of facts and phenomena, with here and there a suggestive inference or an indication of lines for further observation, wisely refraining from what would have been more or less profitless discussions, the times not yet being ripe for broad generalizations on the subjects of which he treats. The material which is discussed has been well digested and is well arranged, and the style, though retaining here and there somewhat of the flavor of the note-book, is on the whole clear and concise. The book is a readable one, and the descriptions and criticisms of methods employed in experimentation, and the bibliographical lists at the conclusion of each chapter, contribute materially to the value the book possesses for both the morphologist and the physiologist.

It is a question, however, if the title chosen for the work is applicable so far as the first part is concerned. The action of poisons, heat, light and electricity on protoplasm, chemotaxis, rheotaxis, geotaxis and similar phenomena, as well as those of acclimatization to various chemical and physical forces, can hardly be considered as falling within the domain of morphology. They are undoubtedly physiological questions. Indeed, the ground which Dr. Davenport here covers is discussed by Verworn, in a somewhat more general manner, in the fifth chapter of his *Allgemeine Physiologie*. Nevertheless, the questions discussed are of the highest interest to morphologists, and Dr. Davenport has placed his *confrères* under great obligations by placing in their hands so lucid an exposition of that side of physiology which especially appeals to them.

Owing to the careful thoroughness with which Dr. Davenport has labored, the work is comparatively free from oversights. It is to be regretted, however, that the author has seen fit to confine his attention almost exclusively to organisms as a whole, to the neglect of considerable valuable information to be derived from observations on vertebrate tissues. The action of poisons, for example, on the peculiarly unstable protoplasm of the vertebrate nervous system is hardly treated with the fullness which its interest and importance demand, and insufficient attention is given to the numerous results of general significance which have been obtained by the study of electrical stimulation of muscle and nerve protoplasm. We miss, too, a discussion of the effects of surface tension in producing movements of protoplasm, a question which has been considered by Ryder in several publications. A few typographical errors are noticeable, though none are serious, but a great defect consists in the absence of an index, a defect which may be remedied in the concluding volume. A separate index for each part would, however, be a great convenience.

J. P. McMurrich.

University of Michigan, May 23, 1897.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, MAY–JUNE, 1897.

UNDER the title 'The Last Great Baltic Glacier,' Dr. James Geikie replies to the recent criticism by Dr. Keilhack.* He gives a brief re-statement of the evidence presented in the *Great Ice Age* for the belief that the great terminal moraines of the Baltic Ridge are products of an independent glacial epoch, quoting Du Pasquier on disputed points.

The post-Pleistocene elevation of the Inyo range and the Waucobe lake beds of California are discussed by C. D. Walcott. A series of well characterized lake beds in the foot hills of the Sierra Nevada are described. The beds contain fossils any of which 'might be recent or Pliocene' as determined by Dall, but of which the probable age is believed to be Pleistocene. The beds have a maximum thickness of 150 feet and in character resemble the ancient sediments of Lake Lahontan. The strata lie at very different levels. There is evidence of faulting and it is believed that there has been recent elevation to the amount of about 3,000 feet. In this connection the Owen Valley earthquake of 1872 is recalled.

In the fifth of his Italian Petrological Sketches, Dr. Henry S. Washington gives a general summary. The composition of the rocks of the Ciminite-Vulsinite-Toscanite series is discussed and its relationships to the Absorakite-Shoshonite-Banakite series as well as to other intermediate groups is illustrated by analyses and tables. The trachydolerites and the leucitic rocks are also discussed as to composition and relationship.

Dr. H. F. Reid gives a summary of the first annual report of the International Committee on Glaciers. Under each country notes relative to the present phase of glaciation is given. Of the Alpine glaciers a considerable number show the phase of increase. In America the glaciers are in general retreating, though some show the contrary phase. In 1896 the glaciers of Cook's Inlet, Chilcat Pass, and the Glacier Bay region, as well as those of Mt. Ranier, Mt. Hood and the Selkirk mountains were all reported as decreasing.

A sketch of the Geology of Mexico, based upon the recently issued reports of the Geological Institution of Mexico, is presented by Mr. H. F. Bain.

Among the reviews is an extended discussion, by Mr. C. F. Tolman, of the recent papers by Dr. G. F. Becker on rock differentiation.*

* *Jour. Geol.*, V., 113–125.

* *Amer. Jour. Sci.* (4), Vol. III., pp. 21–40, Jan., 1897.

SOCIETIES AND ACADEMIES.

TORREY BOTANICAL CLUB, WEDNESDAY, APRIL 28, 1897.

PROFESSOR L. M. UNDERWOOD, Chairman, Professor N. L. Britton, Secretary, *pro tem.*

The first paper was by Professor L. M. Underwood, 'Notes on the Ferns of Japan.'

The immediate occasion of this paper was the receipt during the past year of two separate collections of Japanese ferns of about 50 species each.

The insular position of Japan, together with a considerable range of latitude, equalling that from St. Paul, Minn., to Mobile, Ala., gives Japan a larger proportion of ferns than we have in the United States, although the area of the islands is only that of the northeastern States as far as the Virginias, together with about one-half of Ohio.

The ferns are those of temperate climates and agree well with those of the adjacent mainland so far as the latter are known. A few subtropical forms enter the flora, but the really tropical species do not reach the islands.

Many species are common inhabitants of Europe as well as the eastern United States, but the ferns of Japan offer very little support to the once prevalent notion of the great similarity to the flora of the eastern United States. In fact about as many Japanese species have as many near allies in Pacific America as in other portions of the country if we exclude the species quite generally distributed through the north temperate zone.

Discussing the paper, Professor Britton cited a number of instances among spermatophytes, in which species supposed to be common to Japan and eastern North America had been

shown to be distinct. He maintained that the theory of migration, as ordinarily accepted, was insufficient to account for such similiarity between the floras of the two regions as actually exists. Mr. T. H. Kearney, Jr., remarked that in comparing the grass-flora of the two regions he had found that, exclusive of circumboreal species, only two species are in common.

The second paper was by P. A. Rydberg, entitled 'Floral Features of Western Nebraska.'

It is a popular misconception that the country from Illinois to the Rocky Mountains constitutes one undifferentiated region. In fact, there are two entirely different regions, viz: 1. The prairie region, with rich loam and a comparatively good supply of rain and extending into the eastern Dakotas, Nebraska and Kansas. 2. The region of the Great Plains, with dry, hard soil and scanty rainfall and comprising the western portion of said States, eastern Colorado and Montana and the larger portion of Wyoming.

The plains are mostly covered by short grasses, the so-called Buffalo grasses. In the hot, dry autumn these become self-cured and form an excellent winter pasture for the stack. A little hay is cut on the lowlands and fed to the animals during snow storms. Otherwise the cattle and horses feed out during the whole winter. The Buffalo grasses are: the original Buffalo grass, *Bulbilis dactyloides;* Blue and Black Grama, *Bouteloua oligostacha* and *hirsuta*, and 'Nigger Heads,' *Carex filifolia.*

In a region where the rainfall is comparatively scant and distributed only during certain seasons of the year the plants must be so constituted as to be able to withstand a good deal of drought. In other words, the evaporation must either be reduced to a minimum or the plant must have special stores of water. The plants peculiar to this region may be divided into the following groups:

1. Very hairy plants generally covered with thick pannose pubescence, which retain the moisture, as species of *Eriogonum*, *Astragalus*, *Eurotia*, *Senecio*, *Evolvulus* and *Artemisia.*

2. Plants with glaucous foliage having a hard epidermis, as *Yucca glauca*, *Rumex venosus*, *Argemone alba* and several grasses.

3. Plants with white, often shreddy bark, as, species of *Mentzelia* and *Anogna.*

4. Plants with very narrow and often involute leaves, as *Lygodesmia juncea* and *rostrata*, and several grasses and sedges.

5. Plants with fleshy stems in which the surface is reduced to a minimum and no leaves, as the Cacti.

6. Plants with a deep-seated, enlarged root as the Bush Morning Glory, *Ipomœa leptophylla*, and the wild pumpkin, *Cucurbita fœtidissima.* Mr. Rydberg had seen a root of the former three feet long and almost two feet in diameter.

7. Plants covered with glands, containing essential oils, as *Dysodia papposa* and *Pectis angustifolia.* The oil is supposed by some to have a cooling effect, partly by taking up heat when evaporated and partly by surrounding the plant by a cooler atmosphere, their specific heat being much less than the air.

Two papers followed by Dr. J. K. Small: (a) 'The Sessile-flowered *Trillia* of the Southern States,' (b) 'Notes on Epilobiaceæ.' Both papers are published in the April number of the *Bulletin.*

N. L. Britton,
Secretary pro tem.

ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

The annual meeting of this society was held in the city of Birmingham on the 18th instant.

Mr. W. M. Brewer read a paper on Copper Mining in Alabama, in which he stated that the old Woods copper mine in Cleburne county had recently been taken in hand by a company which was doing a large amount of work in raising the ore, which is a copper-bearing pyrrhotite.

Mr. T. H. Aldrich gave an account of the work in which he has lately been engaged in preparing to mine and mill the gold-bearing quartz veins of Hog Mountain, in Tallapoosa county. This is a low-grade ore, but it can be mined and milled at a very small cost, and as the quantity is very great the proposed operations are to be on a large scale. In connection with this paper, the discussion brought out the fact that the working of similar low-grade ores has been very profitably carried on for about a year in the Idaho district, in Clay county, and Mr. Aldrich predicts that a number of gold-

mining plants will soon be in successful operation in the State. The recent reports of the State Geological Survey have shown that low-grade gold ores occur in large quantity at several localities in Alabama, and, since the success of the operations at Idaho has been fully demonstrated, the attention of capitalists has been directed to this inviting field.

Dr. Eugene A. Smith gave a short account of his recent visit to northwestern Texas for the purpose of inspecting again the sulphur deposits of that region. He exhibited some photographs taken by him which gave a good idea of the character of the scenery there.

Mr. Charles Geohegan gave to the Society some statistics concerning the relative cost of making mining engines and other mining machinery in Birmingham and in cities farther north.

Mr. J. W. Sibley read an instructive paper on the manufacture of vitrified brick, illustrating his remarks with a number of specimens of the crude material in various stages of its preparation and of the finished product. The material used in this manufacture is a gray shale, occurring in the Coal Measures of this State, in the vicinity of Coaldale, in Jefferson county.

Mr. Brewer then gave a report upon his success in the collection of the statistics of mineral production in Alabama, under the auspices of the State Geological Survey and this Society. He announced that for the past month he had succeeded in collecting statistics of about 95% of the total production, and said that he hoped to be able to have complete returns in the course of a few months. The statistics are collected monthly and sent out to the technical journals of the country and to the leading newspapers of the State.

Mr. Paschal Shook made the statement that the Birmingham Steel Mill Company were building two forty-ton basic open-hearth furnaces, which would probably be finished in the course of two months. They expect to be able to furnish steel billets to all the rolling mills of this section.

In his address the retiring President, Mr. F. M. Jackson, urged upon the members of the Society to exert themselves to increase the membership and with it the influence for good of this Society.

Officers for the ensuing year were elected as follows: President, Truman H. Aldrich, of Birmingham; Vice-Presidents, J. W. Minor, of Thomas, and J. A. Montgomery, of Birmingham.

EUGENE A. SMITH,
Secretary.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 264th regular meeting of the Society was held Tuesday, May 18, 1897. Professor Otis T. Mason exhibited a peculiar shaped boat from the Kootenay river, which in bow and stern was not unlike the modern ram or monitor, having a double point under water. The little model had been in the Smithsonian for forty years and was said to be an exact representation of the boats in use along certain parts of the Columbia river. It is made of the whole skin of the pine tree, and thus differs from the birch-bark canoe, which is made of pieces. This is reversed, so that the bast is outside and the bark inside; the ends are then drawn together and cut obliquely or with a slight curve from above downward, causing the bottom to project at either extremity, forming a point.

A line drawn across the Mercator map to Asia will strike the Amoor river, where practically the same style of boat is found, and the question was raised whether it showed contact or independent origin, and from the great resemblance it was thought the former, showing the migration of canoe forms from Asia to America.

Professor Mason premised these remarks by an outline upon the evolution of the boat. In the study of progress, water travel divides itself into *flotation* and navigation, the former meaning simply keeping above the surface, the latter including the higher problem of movement in a determined direction. Navigation includes the two elements of the hull and of the mechanism of movement. Propulsion may thus be represented:

Propulsion { Muscular, man or beast, { as in swimming, poling, paddling, rowing or cordeling.
Physical { wind, sail, steam and electricity.

The types of American aboriginal boats as conditioned by exigencies were then considered, beginning at the extreme north:

Kyack, or swift flying or man's boat for seal hunting. Umack, or scow or woman's boat for transportation.

Canada and northern United States, birch canoe, Haida.

Lower down on Pacific coast, Dugout, Klinkit, Chinook.

Inland, Columbia river, Kootenay.

Missouri river, Bull boat, which is nothing but a sort of crate with bull hide over it and pulled by a rawhide line, *i. e.*, towed.

South in East, Pirogue or dugout of soft log.

South and West, reed float or raft, reed catamaran.

On Pacific side of South America, Balsa.

In the interior and southward, woodskin.

The forms of boats are products of several causes or exigencies cooperating. The exigency of water is the study of the kind of water and its conduct, and the natives have everywhere studied the nature of water. The craft has resulted by a sort of natural selection. Thus at the mouth of the Yukon river the kyack is decked over with seal skin to keep off the spray; farther up the river is a birch-bark kyack partially decked; while still above it is an open birch canoe with no decking, on account of the rapids.

Exigency No. 2. Material, thus no Sioux made a boat of log, because there are no logs in his country, but have buffalo hide, and the propulsion is by women swimming, drawing the craft with a line.

Exigency No. 3. Function or use of boat. Thus for its purpose of swiftness the Esquiman kyack is built on the same lines as the best racing shells.

Exigency No. 4. Ethnic genius or the particular way or style of making by a people or tribe.

Discussed by Messrs Hough, Stetson, Sternberg, Pierce and McCormick.

Mr. Wells M. Sawyer read a paper on 'Jodocus Hondius Illustrations,' and exhibited one of the early maps of North America, 1607, containing many curious illustrations.

The principal of these is one in the lower left-hand corner of the sheet, showing 13 Indians from Brazil preparing a favorite intoxicant. The costuming, form of vessels and details of manipulation are truthfully given; to the right is a group of women biting and chewing the root which they afterwards spit into the large bowl from which others are pouring into an olla around which a fire is burning. Each illustration is accompanied by a Latin inscription of explanation. Another illustration of interest to the anthropologist is the throwing stick.

Discussed by Messrs Mason, Flint, Pierce, McGee and Sawyer.

Mr. James H. Blodgett read a paper on the 'Weak Places in our Public Education,' devoting the subject-matter principally to the study of geography in the public schools; he presented a number of old atlases, ranging from 100 to 20 years old and showing what slight changes had been made in the books used in 1820 and those used to-day and the unfitness of the latter for use with our present knowledge of such things.

Discussed by Messrs Flint and McCormick.

Professor W J McGee gave a paper on 'Present Condition of the Muskwaki Indians.' These Indians, known as the Sac and Fox, were at one time independent tribes near the Atlantic, but confederated for the purpose of warring against the Sioux; the Sac furnishing the principal chiefs up to the time of the Black Hawk War. They then moved to Iowa and bought land, and vested the title in the Governor of the State in trust, *ex-officio*, and now have about 3,000 acres. Their condition is quite primitive, and they are what are termed blanket and moccasin Indians.

They build winter and summer houses, the former ellipsoid in form, covered with mats made of rushes, sewed with cord manufactured by themselves; the summer house is rectangular, covered with the bark of the basswood or linden.

There is a symbolism connected with the building of their houses. They have many curious beliefs.

Discussed by Mr. Chas. Moore.

The Society adjourned for the summer.

J. H. McCormick,
General Secretary.

SCIENCE

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FRIDAY, JUNE 18, 1897.

CONTENTS:

The Beginnings of American Astronomy: EDWARD S. HOLDEN.....929
Inheritance of Acquired Characteristics: JOHN M. MACFARLANE.....935
Current Notes on Physiography:—
Uplands and Valleys of Kansas; Bell on Canadian Rivers; The Plateau of West Virginia; Crater Lake and Mt. Mazama, Ore.: W. M. DAVIS.....945
Current Notes on Anthropology:—
Man and His Environment; Slavery of the American Indians: D. G. BRINTON.....947
Notes on Inorganic Chemistry: J. L. H.....948
Scientific Notes and News.....950
University and Educational News.....9...54
Discussion and Correspondence:—
The Distribution of Marine Mammals: THEO. GILL, G. BAUR, ARNOLD E. ORTMANN. *The Potter's Wheel in America:* D. G. BRINTON.....955
Scientific Literature:—
Cambridge Natural History, Vol. II.: W. MCM. WOODWORTH. *Wilson on the Swastika; de Mortillet's L'Origine de la Nation Française:* D. G. BRINTON.....958
Scientific Journals:—
The American Chemical Journal: J. ELLIOTT GILPIN.....961
Societies and Academies:—
The Biological Society of Washington: F. A. LUCAS. *Boston Society of Natural History:* SAMUEL HENSHAW.....963
New Books.....964

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE BEGINNINGS OF AMERICAN ASTRONOMY.

IT is impossible, even in the briefest sketch, not to emphasize the debt of American science and learning to the intelligent interest and patronage of our early Presidents—Washington, John Adams, Jefferson, Madison, Monroe, John Quincy Adams. The powerful impetus given by them and through them has shaped the liberal policy of our governments, National and State, towards education and towards science. Sir Lyon Playfair, in his address to the British Association for the Advancement of Science (1885), has recognized this influence in the truest and most graceful way. He said: "In the United Kingdom we are just beginning to understand the wisdom of Washington's Farewell Address to his Countrymen (1796) when he said: 'Promote, as an object of primary importance, institutions for the increase and diffusion of knowledge; in proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened.'"

Until the Revolution (1776) American science was but English science transplanted, and it looked to the Royal Society of London as its censor and patron. Winthrop, Franklin and Rittenhouse were, more or less, English astronomers. Franklin was the sturdiest American of the three. As early as 1743 he suggested the formation of the American Philosophical Society of Philadelphia. John Adams founded the American Academy of Arts and Sciences in Boston in 1780. These two societies, together with Harvard College (founded in

1636), Yale College (1701), the University of Virginia (founded by Jefferson in 1825) and the United States Military Academy at West Point (1801), were the chief foci from which the light of learning spread. Other colleges were formed or forming all over the Eastern and Middle States during the early years of the century.

The leading school of pure science was the Military Academy at West Point, and it continued to hold this place until the Civil War of 1861. From its corps of professors and students it gave two chiefs to the U. S. Coast Survey; and the army, particularly the corps of engineers, provided many observers to that scientific establishment, besides furnishing a large number of professors and teachers of science to the colleges of the country. The observatory of the Academy was founded by Bartlett, in 1841, and much work was done there, only a small part of which is published. The Coast Survey was a school of practice for army officers, and their experience was utilized in numerous boundary-surveys during the period 1830–50. Colonel J. D. Graham, for example, was Astronomer of the survey of the boundary between Texas and the United States in 1839–40; Commissioner of the Northeast boundary survey 1840–43; Astronomer of the Northwest boundary survey 1843–47; of the boundary between the United States and Canada 1848–50; of the survey of the boundary between Pennsylvania and Virginia 1849–50; of the boundary survey between Mexico and the United States 1850–51. The names of Bonneville, Talcott, Cram, Emory and other army officers are familiar in this connection, and their work was generally of a high order. It was in such service that Talcott invented or reinvented the Zenith Telescope, now universally employed for all delicate determinations of latitude. The mechanical tact of Americans has served astronomy well. The sextant was invented by Thomas Godfray, of Philadelphia, in 1730, a year before Hadley brought forward his proposal for such an instrument.* The chronograph of the Bonds, the Zenith Telescope of Talcott and the break-circuit chronometer Winlock are universally used to-day. The diffraction-gratings of Rutherfurd were the best to be had in the world till they were replaced by those of Rowland. The use of a telescope as a collimator was first proposed by Rittenhouse. The pioneer opticians of the United States were Holcomb (1826), Fitz (1846 or earlier), Clark (1845), Spencer (1851). Only the Clarks have a world-wide reputation. Würdemann, instrument maker to the U. S. Coast Survey (1834) had a decided influence on observers and instrument-makers throughout the United States, as he introduced extreme German methods and models among us, where extreme English methods had previously prevailed. The system of rectangular land surveys which proved to be so convenient for the public lands east of the Rocky Mountains was devised and executed by Mansfield, a graduate of the Military Academy.

The list of army officers who became distinguished in civil life as professors in the colleges of the country is a very long one. Courtenay (class of 1821 at West Point) was professor of mathematics at the University of Pennsylvania, 1834–36, at the University of Virginia, 1842–43, and was the author of admirable text-books. Norton (class of 1831) became professor at New Haven, and wrote a very useful text-book of astronomy in 1839; and the list

* In 1700 Sir Isaac Newton sent drawings and descriptions of a reflecting sextant to Halley for his advice. At Halley's death these were found among his papers. Hadley's device (1731) was undoubtedly derived from Newton's MSS. The Royal Society of London granted £200 to Godfray for his invention which his brother, Captain Godfray, had previously put into practical use in the West Indies.

could be much extended. The excellent training in mathematics at West Point (chiefly in French methods) early made itself felt throughout the whole country. The mathematical text-books of Peirce of Harvard and of Chauvenet of the Naval Academy, brought the latest learning of Europe to American students. Mitchell (class of 1829 at West Point) was the only graduate who became a professional astronomer (1842–61). His direct service to practical observing astronomy is small, but his lectures (1842–48), the conduct of the Cincinnati observatory (1845–59), and his publication of the *Sidereal Messenger* (1846–48), together with his popular books, excited an intense and widespread public interest in the science, and indirectly led to the foundation of many observatories. He was early concerned in the matter of using the electric current for longitude determinations and his apparatus was only displaced because of the superior excellence of the chronograph devised by the Bonds. His work was done under immense disadvantages, in a new community (Ohio), but the endowment of astronomical research in America owes a large debt to his energy and efforts.

The Navy and the U. S. Naval Academy (founded by Bancroft in 1845, at the suggestion of Chauvenet) were very active in astronomical work. Chauvenet (Yale College, 1840) published a text-book of Trigonometry, in 1850, which had an important share in directing attention to rigid, elegant and general methods of research. His astronomy (1863) is a hand-book for all students. Walker, Gilliss, Coffin, Hubbard, Ferguson, Keith, Yarnall, Winlock, Maury, Wilkes, were all connected with the Navy, more or less intimately. Walker's career was especially brilliant; he graduated at Harvard College in 1825, and established the Observatory of the Philadelphia High School in 1840. He was the leading spirit in the U. S. Naval Observatory at Washington (1845–47) and introduced modern methods into its practice at the beginning. From the Observatory he went to the Coast Survey to take charge of its longitude operations, and he continued to direct and expand this department until his death, in 1853. To him, more than to any single person, is due the idea of the telegraphic method ('the American method') of determining differences of Longitude. His assistant in this work was Gould, who succeeded to the charge of it in 1853. His researches extended to the field of mathematical astronomy also, and his theory of the planet *Neptune* (then newly discovered) marks an important step forward. His investigations and those of Peirce were conducted in concert and attracted general and deserved attention.

The exploring expedition of Wilkes required corresponding observations to be made in America, and during the period 1838–42 William Bond, at Dorchester, and Lieutenant Gilliss, at Washington, maintained such a series with infinite assiduity and with success. The results of Gilliss' astronomical expedition to the southern hemisphere (Chile, 1849–52) were most creditable to him and to the navy, though his immediate object—the determination of the solar parallax—was not attained.

The Coast Survey began its work in 1817 under Hassler, a professor from West Point, who impressed upon the establishment a thoroughly scientific direction. Bache, his successor (a grandson of Benjamin Franklin), was a graduate of West Point in the class of 1825, and took charge of the Survey in 1843. He is the true father of the institution, and gave it the practical efficiency and high standard which characterized its work. He called around him the flower of the army and navy, and was ably seconded by the permanent corps of civilian assistants —Walker, Saxton, Gould, Dean, Blunt,

Pourtales, Boutelle, Hilgard, Schott, Goodfellow, Cutts, Davidson and others.

Silliman's (& Dana's) *American Journal of Science* had been founded at New Haven in 1818, and served as a medium of communication among scientific men. A great step forward was made in the establishment of the *Astronomical Journal* by Dr. Gould on his return from Europe at the close of 1849.* *Silliman's Journal* was chiefly concerned with the non-mathematical sciences; though it has always contained valuable papers on mathematics, astronomy and physics, especially from the observers of Yale College—Olmsted, Herrick, Bradley, Norton, Newton, Lyman and others. In Mason, who died in 1840 at the age of 21, the country lost a practical astronomer of the highest promise.† *Gould's Journal* was an organ devoted to a special science. It not only gave a convenient means of prompt publication, but it immediately quickened research and helped to enforce standards already established and to form new ones. The *Astronomical Notices* of Bruennow (1858–62) might have been an exceedingly useful journal with an editor who was willing to give more attention to details, but, in spite of Bruennow's charming personality and great ability, it had comparatively little influence on the progress of the science.

The translation of the *Mécanique Céleste* of Laplace by Nathaniel Bowditch, the supercargo of a Boston ship (1815–17), marks the beginning of an independent mathematical school in America. The first volume of the translation appeared in 1829; at that time there were not more than two or three persons in the country who could read it critically. The works of the great mathematicians and astronomers of France and Germany — Laplace, Lagrange, Legendre, Olbers, Gauss, W. Struve, Bessel—were almost entirely unknown.

Bowditch's translation of the *Mécanique Céleste*, and, still more, his extended commentary, brought this monumental work to the attention of students and within their grasp. His *Practical Navigator** contained the latest and best methods for determining the position of a ship at sea, expressed in simple rules. American navigators had no superiors in the first half of this century. Nantucket whalers covered the Pacific, Salem ships swarmed in the Indies, and the clipper-ships made passages round the Horn to San Francisco, which are a wonder to-day. Part of their success is due to the bold enterprise of their captains (who were said to carry deck-loads of studding-sail booms to replace those carried away!), but an important part depended on their skill as observers with the sextant. One of the sister ships to the one of which Bowditch was supercargo was visited at Genoa by a European astronomer of note (Baron de Zach), who found that the latest methods of working lunar distances to determine the longitude were known to all on board, sailors as well as officers. His bewilderment reached its climax when the navigator called the negro cook from the galley and bade him expound the methods of determining the longitude to the distinguished visitor.

On Bowditch's own ship there was "a crew of twelve men, everyone of whom could take and work a lunar observation as well, for all practical purposes, as Sir Isaac Newton himself." Such crews were only to be found on American ships in the palmy days of democracy. All were cousins or

*The *Astronomische Nachrichten* had been founded in Altona, by Schumacher, in 1821.

†See the *International Review*, Vol. X., p. 585.

*First edition, 1802. Sumner's method in navigation (1843)—a very original and valuable contribution from a Boston sea-captain—and Maury's Wind and Current Charts, begun in 1844, are two other notable contributions from a young country to an art as old as commerce.

neighbors, and each had a 'venture' in the voyage. But these anecdotes may serve as illustrations of the intellectual awakening which came about as soon as our young country was relieved from the pressure of the two wars of 1776 and 1812. An early visitor, Baron Hyde de Neuville (1805), felt 'an unknown something in the air,' 'a new wind blowing.' This new spirit, born of freedom, entered first into practical life, as was but natural; science next felt its impulse, and, last of all, literature was born. Emerson hailed it (in 1837) 'as the sign of an indestructible instinct.' "Perhaps the time is already come," he says, "when the sluggard intellect of this country will look from under its iron lids and fill the postponed expectation of the world with something better than the exertions of mechanical skill. Our day of dependence, our long apprenticeship to the learning of other lands, draws to a close. The millions that around us are rushing into life cannot always be fed with the sere remains of foreign harvests."

Benjamin Peirce, a graduate of Harvard in the class of 1829, had been concerned with the translation of the *Mécanique Céleste*, and was early familiar with the best mathematical thought of Europe. He became professor in Harvard College in 1833, and, after the death of Bowditch in 1838, he was easily the first mathematical astronomer in the country. His instruction was precisely fitted to develop superior intelligences, and this was his prime usefulness. Just such a man was needed at that time. Besides his theoretical researches on the orbits of the planets (specially *Uranus* and *Neptune*) and of the moon, his study of the theory of perturbations, and his works on pure mathematics and mechanics, he concerned himself with questions of practical astronomy, although the observations upon which he depended were the work of others. He was the consulting astronomer of the *American Ephemeris* and *Nautical Almanac* from its foundation in 1849, and its plans were shaped by him to an important degree. His relative, Lieutenant Davis, United States Navy (the translator of Gauss' *Theoria Motus Corporum Cœlestium* (1857)), was placed in charge of the *Ephemeris*, and the members of its staff—Runkle, Ferrel, Wright, Newcomb, Winlock and others—most effectively spread its exact methods by example and precept. Professor Peirce undertook the calculations relating to the Sun, *Mars* and *Uranus* in the early volumes of the *Ephemeris*. As a compliment to her sex, Miss Maria Mitchell was charged with those of *Venus; Mercury* was computed by Winlock, *Jupiter* by Kendall, *Saturn* by Downes, *Neptune* by Sears Walker.

The Smithsonian Institution was founded in 1846, and Joseph Henry was called from Princeton College to direct it. There never was a wiser choice. His term of service (1846–78) was so long that his ideals became firmly fixed within the establishment and were impressed upon his contemporaries and upon a host of younger men. The interests of astronomy were served by the encouragement of original research through subsidies and otherwise, by the purchase of instruments for scientific expeditions, by the free exchange of scientific books between America and Europe, and by the publication of the results of recondite investigations. It is by these and like services that the Institution is known and valued among the wide community of scientific men throughout the world.

But this enumeration of specific benefits does not convey an adequate idea of the immense influence exercised by the Institution upon the scientific ideals of the country. It was of the first importance that the beginnings of independent investigation among Americans should be directed towards right ends and by high and unselfish aims. In the formation of a scien-

tific and, as it were, a moral standard a few names will ever be remembered among us; and no one will stand higher than that of Henry. His wise, broad and generous policy and his high personal ideals were of immense service to his colleagues and to the country.

The establishment of a National Observatory in Washington was proposed by John Quincy Adams in 1825; but it was not until 1844 that the U. S. Naval Observatory was built by Lieut. Gilliss, of the Navy, from plans which he had prepared. By what seems to have been an injustice Gilliss was not appointed to be its first Director.* This place fell to Lieut. M. F. Maury. Gilliss had been on detached service for some years, and a rigid construction of rules required that he should be sent to sea, and not remain to launch the institution which he had built and equipped.

The first corps of observers at Washington (1845) contained men of first-class ability—Walker, Hubbard, Coffin. Gilliss's work as astronomer to Wilkes Exploring Expedition (1838–42) at his little observatory on Capitol Hill, had shown him to be one of the best of observers, as well as one of the most assiduous. His study and experience in planning and building the the Naval Observatory had broadened his mind. To the men just named, with Peirce, Gould and Chauvenet, and to their coadjutors and pupils, we owe the introduction of the methods of Gauss, Bessel and Struve into the United States, and it is for this reason that American astronomy is the child of German, and not of English science.

The most natural evolution might seem to have been for Americans to follow the English practice of Maskelyne and Pond. But the break caused by the War of Independence, by the War of 1812, and by the years necessary for our youthful governments to consolidate (1776–1836) allowed our young men of science to make a perfectly unbiased choice of masters. The elder Bond (William Cranch Bond, born 1789, Director of Harvard College Observatory, 1840–1859) was one of the older school and received *his* impetus from British sources during a visit to England in 1815.

In estimating the place of the elder Bond among scientific men it is necessary to take into account the circumstances which surrounded him. He was born in the first year of the French Revolution (1789); he was absolutely self-taught; practically no astronomical work was done in America before 1838. When Admiral Wilkes was seeking for coadjutors to prosecute observations in the United States during the absence of his exploring expedition he was indeed fortunate in finding two such men as Bond and Gilliss. Their assiduity was beyond praise and it led each of them to important duties. Bond became the founder and Director of the Observatory of Harvard College, while Gilliss is the father of the United States Naval Observatory at Washington, as well as of that of Santiago de Chile, the oldest observatory in South America. Cambridge, though the seat of the most ancient university in America, was but a village in 1839. The College could afford no salary to Bond, but only the distinction of a title, 'Astronomical Observer to the University,' and the occupancy of the Dana house, in which his first observatory was established. His work there, as elsewhere, was well and faithfully done, and it led the College authorities to employ him as the astronomer of the splendid observatory which was opened for work in 1847. At that time the two largest telescopes in the world were those of the Imperial Observatory of Russia (Poulkova) and its com-

*He was, however, Director during the years 1861–65.

panion at Cambridge. Each of these instruments has a long and honorable history. Their work has been very different. Who shall say that one has surpassed the other? We owe to Bond and his son the discovery of an eighth satellite to *Saturn*, of the dusky ring to that planet, the introduction of stellar photography, the invention of the chronograph by which the electric current is employed in the registry of observations, the conduct of several chronometric expeditions between Liverpool and Boston to determine the Transatlantic longitude, and a host of minor discoveries and observations.

Gilliss visited France for study in 1835, before he took up his duties at Washington. The text-books of Bond and Gilliss were the Astronomies of Vince (1797–1808) and of Pearson (1824–29). The younger Bond (George Phillips Bond, born 1825, Harvard College 1844, Director of the Harvard College Observatory 1859–65) and his contemporaries, on the other hand, were firmly grounded in the German methods, then, as now, the most philosophical and thorough.

It was not until 1850, or later, that it was indispensable for an American astronomer to read the German language and to make use of the memoirs of Bessel, Encke and Struve and the text-books of Sawitsch and Brünnow.* This general acquaintance with the German language and methods came nearly a generation later in England. The traditions of Piazzi and Oriani came to America with the Jesuit Fathers of Georgetown College (1844), of whom Secchi and Sestini are the best known.

The dates of the foundation of a few observatories of the United States may be set down here. Those utilized for the observation of the transit of Venus in 1769 were temporary stations merely. The first college observatory was that of Chapel Hill, North Carolina (1831); Williams College followed (1836); Hudson Observatory (Ohio) (1838); the Philadelphia High School (1840); the Dana House Observatory of Harvard College (1840); West Point (1841); the United States Naval Observatory (1844); the Georgetown College Observatory (1844); the Cincinnati Observatory (1845); the new observatory of Harvard College (1846); the private observatory of Dr. Lewis M. Rutherfurd in New York City (1848); the observatory at Ann Arbor (1854); the Dudley Observatory at Albany (1856), and that of Hamilton College (1856).

These dates and the summary history just given will serve to indicate the situation of astronomy in the United States during the first half of the present century. A little attention to the dates will enable the reader to place an individual or an institution on its proper background. It must constantly be kept in mind that the whole country was very young and that public interest in astronomical matters was neither educated nor very general. The data here set down will have a distinct value as a contribution to the history of astronomy in America. The developments of later years have been so amazing that we forget that the first working observatories were founded so late as 1845.

American science is scarcely more than half a century old. The day will soon come—it is now here—when we shall look back with wonder and gratitude to ask who were the men who laid the wide and deep foundations which already maintain so noble an edifice.

EDWARD. S. HOLDEN.

MT. HAMILTON, CAL., April, 1897.

*Dr. Bowditch learned to read German in 1818, at the age of 45.

*INHERITANCE OF ACQUIRED CHARACTERISTICS.**

IN approaching the subject of 'The inheritance of acquired characteristics' from

*Paper read at the Boston meeting of The American Society of Naturalists.

the plant side, I believe it may fairly be asserted that the botanist is more favorably provided with subject-matter for investigation than is the zoologist. For thousands of years plants have been grown, selected and disseminated by man, and have thus become his companions, in as true a sense as have the cat, the dog or the horse. For at least a century botanic gardens have existed in all the leading cities of the Old World, for the avowed purpose of promoting scientific information along all lines of plant life. For a couple of centuries or thereby the desire to supply novelties of a useful or decorative kind has stimulated the nurseryman to practice artificial selection, which is just Nature's method at work under high pressure and in the hands of an intelligent conductor. Finally, the botanist, when he pursues his studies afield, deals with organisms that are rooted in definite areas amid definite environments, and from which slow escape by seeding is alone possible.

The present-day student of plant biology thus has four rich sources from which to draw information for the discussion of such topics as that now before us. Unfortunately much valuable knowledge that might have been gleaned is lost to us, since its possible practical application in the future was not recognized in the past. Now the botanist, the horticulturist and the agriculturist are joining hands in an effort to gather, to preserve, and to utilize their stores of information.

Reviewing in thought his different collecting fields, every botanist must be impressed by the fact that certain types of plant are broadly associated with certain surroundings, and particularly is this true of herbaceous plants.

If he attempts to sort out these groups in his mind he will refer most of them to one of the following categories: (1) aquatics, (2) shore or littoral plants, (3) sand or xerophilous plants, (4) shade and humus plants, (5) alpine plants, (6) saprophytic and parasitic plants. Not merely could certain broad principles be laid down for each of these divisions; microscopic study would reveal that in minute details striking similarities reveal themselves in the members of each group. In what follows I do not propose to adhere to the above groupings, but will do so where advisable.

(1) *Aquatic and amphibious plants.* The Buttercup genus (*Ranunculus*) includes about 469 species, some of which are world-wide in distribution. Nearly all are inhabitants of dry or moist soil, but a few like *R. aquatilis* and *R. circinatus* are more or less aquatic. In Europe the former exhibits striking diversity, or heterophylly in the leafage, that is largely determined by the relative depth of water and strength of water current. When growing in ponds or sluggish streams the submerged leaves are dark green, flaccid usually, dissected, and devoid of stomata, but at the ends of the annual shoots and just below the flowers are several floating leaves with expanded, trilobed, light green lamina, that greatly resemble the basal leaves of many land buttercups. Stomata are present over their upper surfaces. In Eastern America the form with submerged leaves alone exists, and even where the plants may be semiterrestrial or completely so, as in the variety *cæspitosus*, the lobed leaves of the European variety do not develop. Such facts cause us to ponder the questions of adaptability and inheritance, but do not in themselves lead us far in our present inquiry.

The Bistort genus (*Polygonum*) is typically a terrestrial one, but includes one species, *P. amphibium*, of highly plastic build. When growing in rather deep water it forms flaccid leaves on long leaf-stalks, and these spring from beside glabrous stipules. On dry land firm leaves with short stalks and hispid stipules appear. These constitute

the varieties *aquaticum* and *terrestre* of some manuals. From F. Hildebrands simple but pretty experiments* we know that plants of the latter variety which have grown for years in dry places will, when submerged a few feet in water, produce shoots that bear in a few weeks the typical floating leaves. While stomata are disposed chiefly over the lower surface of the leaf in the land form, in the aquatic they exist on the upper surface.

Experiments with *Sagittaria*, *Eichornia*, *Potamogeton* and others would demonstrate that in all there is an extreme plasticity of form that permits environmental adaptibility. Comparison with all the species of each genus causes us to inquire whether one of the variation forms has not been acquired through response to stimuli, and has now become a hereditary condition? We need not now stay to answer.

(2) *Shore, littoral or halogen plants.* Abundant along the eastern seaboard is the crimson-flowered *Gerardia purpurea*, that is as variable in habit as it is in the selection of its situation. Within a distance of 100 yards, it may be gathered on a dry exposed sandy bank, and be then about 12 inches high, sparcely branched, faintly red in the leaves, and pale pink in the flowers; or on a flat shady spot in richer soil, when the stem may be 2 feet high, the leaves bright green and elongate, and the flowers pink crimson; or on a rich alluvial mud, when we get a bushy plant 3 feet or more high, that bears long narrow leaves and large showy crimson flowers. But in our botanical manuals *G. maritima* is now given as a true species. It inhabits saline coast-flats, and may even be washed by sea-water without seeming to be injured. A distinctly different plant it looks from the former. From 1 to 8 inches high, it branches little if at all, bears thick succulent reddish-green or glaucous leaves, and one or several small pink flowers.

* Bot. Zeitung, 1870.

On nearly every coast the two can be gathered in close proximity. At Oyster Bay the Shore Railroad separates a drained shore-flat with abundance of *G. purpurea* from an undrained saline swamp that is filled with *G. maritima*, while near Vineyard Haven a drain ditch forms the line of demarcation between the two. Microscopic study of both causes one to ask whether they deserve to be regarded as distinct species. The answer to this may depend wholly on what we call a species, but study of a finely graded set, gathered fully four years ago at Sea Isle, on an inclined bank, would lead me to regard them as common forms that environment has altered. If this be so we should expect that within a longer or shorter period a single individual in its life time, or seminal descendants of such as are gradually 'acclimatized,' will develop macro- and micro-scopic characters similar to those of *Gerardia maritima*. The studies of Lesage* and Russell,† amongst others, yield definite proof. Both have compared, microscopically, individuals of certain species from littoral and inland regions, and the changes undergone by the shore-grown individuals *exactly* correspond with those exhibited by *Gerardia maritima*.

Increase in thickness of the leaf substance chiefly through increase in, and enlargement of, the pallisade cells; an apparent reduction, or possibly wider dispersion, of the chloroplasts; greater lignification of the stem and leaf-bundle elements; enlargement of the vessels; reduction in size of the intercellular spaces, are typical phenomena. The culture experiments of Lesage further verify his field observations. Russell frankly confesses that those grown by him in saline solutions were not so vigorous as those from the Paris basin. Even in this, however, the resemblance to our plant is perfect.

But as Gaston Bonnier has well empha-

* Rev. Gen. de Botanique, Vol. 2, 1890.

† Ann. Sc. Nat. (Bot.), 1895.

sized in his paper on Alpine plants, and as Lesage's work shows, great caution must be exercised in discussing the morphological and physiological relations of species which may grow in close proximity. *Gerardia maritima* is 'at home,' or tries to be, on muddy saline banks, where it is usually protected by the grassy vegetation around. Though we call it a littoral plant, it is modified differently from *Cassia nictitans* or *Yucca filamentosa*, that may be its near neighbors along sand bars. The mention of Yucca can introduce us therefore to that great assemblage that we now call desert or xerophilous plants.

At times met with in full view of the ocean, they are most frequent and attain their most varied development on desert or volcanic areas. Let us linger for a little over *Yucca filamentosa*. Along many miles of the dry sandy ocean front of the Carolinas and Georgia it is a familiar plant. At one season exposed to moist saline breezes, at another to driving winds that hurl the sharp sand particles against it, during a large part of the year exposed to the full glare of hot, sand-reflected sun rays, and never enjoying a superabundance of moisture, though its roots penetrate at least five to six feet below the surface, it still survives and reproduces itself. But it is quite different to the naked eye, and still more so microscopically from the plant that we grow in rich garden soil. Specimens from the ocean beach have a dense, wiry aspect, relatively short, broad, somewhat concave leaves of a glaucous green hue and that end in a hard mucro. Garden plants, on the other hand, that have been cultivated for many years and that may have been themselves reproduced from garden seeds or suckers, bear leaves that are long, narrow and soft leathery in texture, of a dark green hue and with a soft mucro. Seedlings in the neighborhood of each type reproduce their kind.

No matter what the ancestral form may have been or what its natural surroundings, we must here admit acquired characters in one of the types that are reproduced, and our main concern again is to learn whether such changes proceed in the life-time of an individual or can gradually be acquired in either direction by seed selection and propagation. Such papers as those of Duchartre*, Elliot†, Häckel,‡ Lothelier,§ Stenstrom,|| and notably that of Henslow,¶ furnish us with good evidence. For details of Henslow's suggestive paper I would refer you to the original, but Lothelier's studies deserve comment. He varied his experimental methods by making normal air his xerophile environment, and saturated air his new condition.

He summarizes his results alike as to sun and air exposure as follows: (a) stem and leaf substance show a greater amount of indurated tissue in a xerophile state, a reduction of this in a moist atmosphere; (b) the formation of leaf lobes, and, in such as produce them, of spines, is pronounced in a dry atmosphere; (c) the epidermal cuticle is increased, but the epidermal cells are reduced in size, the xylem is connected by a continuous ligneous sheath, and the pericycle is lignified in dry air, while in moist air these features are feebly marked or absent.

It is often stated, and in many cases truly, that the battle in the vegetable world is that of a plant against its neighbors, but with xerophilous plants, that probably cover one-sixth of the earth's surface, the struggle is entirely one between the plant and its physical or animal surroundings. Our native *Opuntia* has had its stem and branches

* Bull. Soc. Bot. de France, 1885.
† Trans. Bot. Soc. Edin., 1891.
‡ Verhand. d. K. K. zool. bot. Gesell. Wien, 1890.
§ Rev. Gen. de Botanique, Vol. 5, 1893.
|| Flora, 1895.
¶ Jour. Linn. Soc. (Botany), Vol. 30, 1894.

shortened, its cuticle thickened, its cells filled with mucilage, its short swollen branches covered with spines, and its now small, succulent, centric leaves short-lived to the extent of a month or six weeks as a gradually perfected resistance to opposing agents. Goebel's experimental results* with the Cacti prove that removal of them to shade and moisture will materially affect their habit.

(4) *Prostrate plants.* In my paper on 'The sensitive movements of some flowering plants under colored screens,'† I described the variations constantly noted in *Cassia nictitans* when grown in the shade on rather moist loam, or in the open on somewhat retentive soil, or when fully exposed to the sun and grown in dry sand. Striking microscopic differences characterize each. This plant is but one of many that show like variations, and not a few of them can be studied as one passes along the quieter streets of our cities. The somewhat loose open growth, ascending branches and spreading leaves of *Euphorbia maculata* when it springs up in a moist shady place differs from those of the humifuse plant with flattly applied leaves that springs up between the bricks of our neglected side walks. Curiously enough, when the latter is attacked by a *Uromyces* the habit of the shade grown plant is assumed. Several grasses, *Portulaca oleracea* and *Mollugo verticillata* are all common humifuse plants when 'baked' in dry places.

(5) *Alpine plants.* Every botanist who has observantly climbed some mountain that rises abruptly from the sea front to an elevation of 3,000–4,000 feet must have been impressed with the change assumed by the vegetation as each successive 1,000 feet is surmounted. On the higher exposed elevations dense, tufted, adpressed plants with short flowering stems and white or bright colored flowers are encountered. These often exhibit close affinity with lowland species of more luxuriant growth and delicate foliage. Are these Alpines then, or the lowland ones, a product of their environment? For the present purpose it will suffice if evidence can be adduced to prove variation transitions from one to the other. Thanks to the beautiful researches of Gaston Bonnier,* supplemented by those of Dufour,† Lazniewski,‡ Leist,§ Wagner|| and Wiesner,¶ we can trace surprising variations within a short period of growth.

Bonnier divided certain plants into three or more parts; he placed one in alcohol, another in a lowland situation, and the remainder on an alpine height. The marvelous transformations wrought in the last are described in the text and faithfully reproduced in his plates. I will content myself with his conclusions. The rhizomes or other underground parts, become lengthened in order the better to store reserve-material, since the aërial period of vegetation is short but intense. The aërial internodes become greatly reduced; the leaves become smaller but considerably thicker; those species that have scattered hairs on low ground have them increased in size; the flowers are reduced in size but brightened in their red and purple colors. Equally marked are the histological changes. Here we have explained the origin of those specific varieties now designated *nana*, *alpina*, etc., which reproduce themselves by seed amid their natural surroundings. How far a plant or group of them when isolated will remain 'true,' or revert, or vary further, we have as yet no experimental data for determining. This much

* Flora, 1895.

† Bot. Central., Vol. 61, 1895.

* Ann. des Sc. Nat. 7th Ser., Vol. 20.

† Ann. des Sc. Nat. 7th Ser., Vol. 5, 1895.

‡ Flora, 1896.

§ Mittheil. der Naturforsch Gesell. von Bern, 1889.

|| Sitz. der Kais. Akad. der Wiss. in Wien, Vol. 2, 1892.

¶ Ber. der Deutsch. Bot. Gesell., Vol. 9, 1891.

can be said, that when apparently fixed species of alpines are transferred to botanic gardens, and cultivated for many years, neither they nor their seed progeny seem to vary appreciably, though it must be granted that a critical comparison has yet to be made. But the comparison which Bonnier has made* between alpines gathered on the Pyrenees, on Jan Mayen and on Spitzbergen, causes us to expect decided differences.

(6) *Parasitic and saprophytic plants.* Volumes might be written in favor of the position that these are alone explicable in terms of their environment. If the Weismannian is in straights over the origin of species amongst the sexless Fungi, more inexplicable seem the sexually perfect flowering parasites. The highly modified and recent order *Scrophulariaceæ* deserves consideration on this continent. To return to the Gerardias that are all more or less pronounced root parasites, such a finely connected series of species as *G. fasciculata*, *G. purpurea*, *G. paupercula* and *G. aphylla* show gradual degradation of the assimilatory organs, as we pass from the Northern to the Southern States. Root, stem and leaf alike all cooperate in the degradation changes. That their floral leaves undergo like reduction suggests a certain rythmic response of the entire organism to altered conditions, and if we pursue our study to those degraded types *Epiphegus*, *Conopholis* and *Orobanche* we see how perfect this response may be. But comparison of Beech Drops (*Epiphegus*) over a pretty wide area of country will afford proof that few plants are more variable, and also that in any one locality the acquired variations are reproduced by this strictly annual species.

(7) *Fasciated plants.* It is now nearly nine years since a botanical friend gathered a wild, fasciated plant of *Polemonium cæruleum* in north Scotland. Its usually slender cylindrical stem was flattened out to a width of about 1½ inches, and from it started a wealth of branches in the axils of the numerous leaves. The plant grew and seeded. Some seeds were retained by him; others were given to the Edinburgh Botanic Garden. From both a considerable proportion of fasciated plants developed. It may at once be objected here that such a teratological state was congenital in the parent plant, but, even granting this for the moment, there seemed strong evidence for its inheritance by the offspring. Long experience in north-central Europe is that fasciation is of rare occurrence. Along our eastern sea-board, especially on sandy soil, with moist substratum, it is frequent. In a single New Jersey meadow 31 specimens of the bulbous Buttercup were gathered by my student party fully four years ago, and prolonged search would have given us more. But an inspection of New Jersey sweet potatoes in the end of September will reveal that from most plants five to eight long shoots radiate outward 20–25 feet. Some are uniform, cylindrical and slender throughout, but half or more of them begin to flatten almost imperceptibly about 5–8 feet from the root region, and are the width of one's hand by the end of a season's growth. They need no further mention, since with us the sweet potato is reproduced by the tuber. But study of such lists as are given in Moquin-Tandon's and Masters' works on plant teratology indicates that plants which, occasionally at least, grow on light soil are those in which such variations occur. De Vries' valuable paper* on the hereditary transmission of fasciation is scientific proof of what every gardener knows to be true. Our now greatly appreciated garden cockscombs, are just monstrous fasciations of the wild *Celosia cristata*, that has a bushy habit, cylindrical stem, numerous leaves, thin

*Rev. gen. de Botanique, Vol. 6, 1894.

*Botanisch Jaarbok, 1894.

branches, and rather loose flower panicles. The wild plant evidently varies readily under cultivation, for several varieties have appeared that are perpetuated true from seed. But no gardener who sows his cockscomb seeds expects all or even the majority to revert to the wild ancestor, though some may more or less perfectly at times. The suggested presence of a fungus that may stimulate to fasciation requires ample confirmation before the view can be accepted.

(7) *Cultivated plants.* Hitherto indications of characters having been acquired have been drawn almost entirely from the wild state, but we must frankly acknowledge that the cases have been few where these characters have been proved to be directly inherited. In cultivated plants we have the strongest possible evidence. At the start let me emphasize the well known fact that the wild type of many of our cultivated plants is unknown. Wheat, oats, barley, corn, the banana, peach, gourd and vegetable marrow are descendants of wild plants that we are still looking for.

Man in his cultural operations has been practicing artificial selection along three lines. He has aimed, first, at a heavy return from individuals, none of which will require special care as individuals, and such we call agricultural crops; second, to obtain a rich fruit supply from individuals that need more detailed attention, and these we commonly call fruit crops; third, to develop a race of showy or handsome decorative plants. The first and second operations have been proceeding for thousands of years, and accordingly we find that the species operated on are those whose wild state we know least about. Be it noted here, however, that artificial selection is very different in its results from the rigorous and impartial selection that works its course in nature. In the latter case those forms survive that are balanced to, or that rise superior to, their environment. In the former man steps in, selects not those types that are hardiest, and in general features fittest for life's battle, but those only which show variations that please him. Such may be the very opposite of desirable in a struggle alongside other plants, or amid such physical conditions as the plant might averagely be exposed to. No wonder then that when man steps out and leaves to their fate the new species that he has evolved, Nature steps in and makes 'short shrift' of them.

Here let me say that many of our most keenly debated biological questions will be largely settled for us in the near future by a diligent study of horticultural and agricultural literature, which, though at times loose, hazy and lacking in exact detail, brings us nearer to the subjects of variation and heredity than does much of our botanical literature. The use that Darwin, Masters, Henslow and Bailey have made of it we all know.

It is impossible in so vast a field to do more than refer to one or two cases. At the World's Fair Horticultural Congress M. de Vilmorin read a paper that in some points settles for us our position in the present debate. Selecting one of the most unlikely of European weeds, the wild Chervil (*Anthriscus sylvestris*), he sowed seeds of it in a selected situation, "in order," says he, "to change its slender and much-forked roots into fleshy, straight and clean roots, say like those of the parsnip. Among the first batch of roots raised from wild seeds a dozen were selected with a tendency in their roots to larger and straighter bodies. Each root was planted separately, and its seed harvested separately. Of the dozen lots obtained, 8 or 9 were discarded at once, and roots were selected only in such lots as exhibited some trace of variation. Again a dozen roots were chosen, a drawing made of each root, which was afterwards planted

separately. For the first ten years the changes were slight, but now they are more and more marked with every generation, and in some of the lots the straight and smooth roots are the most numerous."

Let us briefly trace the history of the Chinese Primrose, which was introduced into English gardens about 1820, but whose natural habitat became known just seven years ago. A variable plant in the wild state, found growing on dry calcareous rocks that are exposed to the broiling sun, it might seem to give little promise of reward for horticultural skill. The first two batches of seedlings reared greatly exceeded expectations, but for years these were propagated chiefly by offshoots. Now garden seeds are entirely used, and few could identify the horticultural prize-taker with the wild specimens collected for the first time a few years ago by Dr. Henry and the Abbe Delavay.

As a somewhat different method of inquiry we have Schindler's comparisons of wheat of the same variety grown in different regions of the world. He finds that the relative amounts of starch and protein vary according to the locality, though samples taken from any one region closely resemble each other.

(9) *Graft plants.* In the literature of gardening the question has often been debated whether the stock and graft reciprocally influence each other. Except in a few rare cases, the negative position has usually been taken, but the experiments of Daniels*, if confirmed and extended, will go far to demonstrate that deep-seated modifications may take place which can be transmitted by seed. When he grafted the cultivated turnip on the wild garlic mustard (*Sisymbrium Alliaria*) the seeds of the turnip produced plants that inclined more to the wild stock. He next reversed the process by growing the wild plant on a cultivated stock. He grew plants of the garlic mustard; some of them he allowed to grow on as control plants; others he grafted on the cultivated cabbage. Seeds were saved and sown from both lots. The former faithfully reproduced the features of the wild parent. Plants reared from the graft garlic seeds were not so tall, the leaves were not so crowded and bore a distinct resemblance to the cabbage, they were of a deeper green color, somewhat plaited, gave a less marked odor of garlic and something of the odor of cabbage. The roots were less woody, the medullary parenchyma was less thickened, the vascular cylinder was reduced but the bast was increased, the bark was more delicate, the chlorophyll more abundant, and the intercellular spaces were reduced as compared with the wild parent.

(10) *Cecidial and domatial plants.* We now approach a subject that is still involved in considerable obscurity, but the bearing of which we believe will greatly aid us in the study of many cell phenomena. Plant galls, or *Cecidia*, in the restricted application of the term, include those outgrowths on leaves or shoots that are caused by insects or mites which undergo development within masses of vegetable tissue, this tissue being produced through excretion of a chemical substance by the hatched grub. Though varying greatly in size, form, consistency and relative abundance, they agree in that the type of tissue built up by the infested plant is diagnostic of the particular species of insect whose egg was deposited. It is not at all uncommon to find eight to ten different galls on one shrub or tree, each rearing a distinct insect species within.

While these have long been known to naturalists, it is only within the past 20 years that attention has been increasingly turned to *Domatia*. These are plant-

* Rev. Gen. de Botanique, 1894; Comptes Rendus, 1892.

growths that attract insects—commonly ants—by offering to them some bait, such as watery liquid or honey. In return the ants commonly act as a body-guard or garrison, and thus protect the entertaining plant from being browsed down by insect enemies. From the investigations of Belt, Beccari, Delpino,* Forbes, Schumman, Treub and others, we now count the number of these as at least 3,000. They fall, however, under two distinct categories: (1) Domatia which are merely extra-floral nectaries, and which may be modified stipules, or may be outgrowths over twigs and leaf surfaces. (2) Domatia in which the entertained insects puncture or excavate some part of the plant. As an outcome, definite holes, cavities or galleries arise, from which plant liquids may escape, or in which the insect-garrison may be appropriately housed. From the researches of Molliard† and Rathay‡ it appears that transition combinations—and some of them very funny—can be traced from *Cecidia* to both kinds of *Domatia*, but in all we have acquired characters of a remarkable kind. It always appeared to me peculiar and somewhat inexplicable, that neither of these should be, so far as our knowledge went, transmissible by seeds. One may cut open thousands of *Cecidia* in their season—chiefly spring—and always the swelling is found to be tenanted by the inciting cause—the insect. The publication of Lundström's paper§ was a welcome one therefore, for, though we could wish for wider verification, his statements seem to be cautiously made. Experimenting with *Rhamnus alaternus* that forms cavernous domatia inhabited by mites, he found that seeds infested by the mites produced seedlings on which the animals propagated rapidly, and at once formed their burrows, while other seeds, selected and cleaned, gave rise to plants that at first showed no signs of domatia, and had no mites, but the later-formed leaves developed the domatia as usual in the axils of the leaf veins. These were smaller and poorer in hairs than the normal growths, but showed no trace of mite.

Equally striking is the history of the well-known Javan plant, *Myrmecodia tuberosa*, and even if we accept with Treub that a small swelling and water canals exist in the unpunctured swelling it seems to me extremely likely that this is acquired and hereditary. My reasons for this opinion are founded on the history of a Bornean pitcher plant, *Nepenthes bicalcarata*, which I have studied from cultivated and from dried imported leaves. First introduced to science and cultivation by Mr. Burbidge, it is now grown in collections and thrives well. At the junction of the tendril with the pitcher and parallel to the latter is an elongated fusiform swelling. About the middle it is pierced, in the wild state, by a neat circular orifice that leads into a cavity resulting from breaking down of soft, loose, water-conducting cells. In the cavity ants reside, and can safely sip the juice that percolates from the liquid-filled pitcher—cavity alongside. I have examined a considerable number of cultivated plants, and on every leaf was a decided swelling filled internally with soft cells. No other species of *Nepenthes* exhibits such an enlargement. Whether cultivated seeds would reproduce the acquired character we are not yet in a position to say.

As regards *Cecidia*, we know that these arise, not immediately after the plant tissues have been punctured by the insect when ovipositing, nor after the egg has been deposited, but only when a larva hatches and exudes some specific irritant. That this irritant should, nevertheless, start in the plant a formation of embryonic tissue that develops in as definite a manner as if it

*Mem. R. Accad. Sc. Ist. Bologna, Vol. 8, 1888.
†Ann. des Sc. Nat., Vol. 1, n. s. 1895.
‡Sitz. K. K. Zool. Bot. Gesell. Wien, 41, 1891.
§Nova acta R. S. Sc. Upsal, Vol. 13, 1886.

were a normal growth of the plant, and which yet, as Molliard has pointed out, produces formations different from the normal tissues, is proof that the protoplasmic reaction of somatic cells to definite chemical stimuli is as exact as it is profound. To cite one concrete example from many that Molliard gives, it can be said that *Arabis sagittata* when attacked by an Aphis shows:—

(*a*) An abundance of hairs of special form on all the organs.

(*b*) A coloration due to a pigment-liquid in the epidermal cells.

(*c*) Longer life of the floral organs.

(*d*) Hypertrophy of cells.

(*e*) Transformation of tissue of varied consistency, into a uniform parenchyma.

(*f*) Death of the sexual cells.

In a condensed paper like this it is impossible to touch on such subjects as the origin and transmission of plant colors, of many heterophyllous modifications, of floral numbers and of floral form, nor can we treat of plant hybrids, of which probably 6,000–7,000 are now known.

I would sum up the position by saying that, while in the earlier illustrations used by me evidence was advanced which favored the idea of characters being acquired even in the life-time of an individual and that represented direct environmental adaptation, in later illustrations, such as those furnished by some xerophilous, some domatial, many cultivated and a grafted plant, direct proof exists of acquired characteristics that are hereditarily transmitted by seed. I have not considered it necessary to speak of bud variations and their seminal reproduction, as these have been so fully dwelt on by Darwin and recently by Bailey. The Neo-Darwinian position seems to me superfluous, because it explains nothing on an exact basis of cause and effect. It is easy to say, when variations or evidences of new adaptability appear in a plant, that these are but the expression of previously latent potentialities, or of variations first contracted or assumed by the germ plasm, and that subsequently exhibit themselves in the somatoplasm. Possibly were the eyes of our understanding enlightened we might discover the budding possibilities of an orchid or an oak in an alga, but before accepting such possibilities it may be well to see whether the Lamark-Darwinian principles cannot guide us perfectly and sufficiently far. Here, however, I would suggest, in contradistinction to Wallace, that indefinite variation must be allowed for. Every plant is a structure built up of extremely complex chemical bodies that are being acted on by external and internal stimuli. We can scarcely suppose that new or modified stimuli are always productive of good and good only. Rather should we consider that in each little plant world, as in our larger physical world, volcanic explosions occur that are in one sense a source of safety for the future, but which leave behind beds and streams of debris that may be useless or even destructive. Various of the plant colors, resins, crystals and other frequent compounds may be explicable primarily as side issues that were for the time useless, even though, as in the compounds just named, we find that they now function beneficially in the plant economy.

Every candid examiner of the facts must admit, however, that sudden and several variations often appear in individuals placed side by side with their like that show no change. I do not see that we possess at present a sufficiently exact knowledge of all the possible factors that may start variation to enable us to explain these. Still this should be no deterrent to our accepting the position that generally explains ascertained facts of structure and function.

It now remains for me to say a few words, as a student of plant cytology, on some of the theories that have been advanced to ex-

plain heredity. Darwin's theory of pangenesis has been pushed aside as a cumbrous impossibility, or at least improbability. Even the modified theories of De Vries and others are only tolerated. Weismann's view, that the chromatic substance is the bearer of heredity, has nearly everything to be said in favor of it, if it be accepted that this substance is found in every living cell. But even then, according to the Neo-Darwinian, it has only a very remote connection with the somatic micellæ. Before resuggesting what has seemed to me a good position that explains details of structure, I may be allowed perhaps to become one more of the number of those who have attempted to rehabilitate Darwin's pangenesis hypothesis.

The wandering of his gemmules to and from definite positions has seemed cumbrous and unlikely, but the most fundamental law of plant and animal physiology is circulation, metabolism and ultimate assimilation as the physiological groundwork of life, growth and heredity. On the plant side physiologists have only realized within the past quarter-century how potent and generally present are ferments of diverse composition and action. Thanks to the labors of Green, Chittenden and others, we further know that highly complex nitrogenous compounds are readily converted from solid into liquid form, and can migrate, in an as yet often mysterious manner, to definite centers of nutrition to be again converted into solids. So far as my knowledge of physics and chemistry leads me, there is no obstacle to our admitting that transfers of complex dissolved materials are passing to the protoplasm, and through it to the chromatin of every cell, more or less affecting its micellar structure. It is necessary, therefore, to learn what relation, if any, exists between the chromatic and plasmatic substance of cells.

In such plants as *Spirogyra* and *Dionæa* I regard the chromatic substance as being demonstrably continuous from the nucleolus through the nucleoplasm to the cytoplasm, where connections are made with the chromatic center of each chloroplast. The so-called pyrenoid-centers in *Spirogyra* behave to stains and reagents as does typical chromatin substance, while radiating chromatic threads pass from them to the nuclear chromatin. Furthermore, in *Spirogyra* an extremely fine chromatic thread-work joins the pyrenoid centers in it transversely or obliquely. What the finer invisible terminations of it in the protoplasm may be, we cannot say, but it appears to me that, if physico-chemical laws are not to be thrown aside, it is a necessity of the case that the delicate chromatic endings in the protoplasm are being acted on, and more or less modified according to the nature of the stimuli that travel to them. As a result of this, a slow, steady but appreciable modification will be effected in the reproductive cells which epitomize the molecular structure of the entire organism that produces them.

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CURRENT NOTES ON PHYSIOGRAPHY.

UPLANDS AND VALLEYS OF KANSAS.

THE second volume of the University Geological Survey of Kansas concerns the western part of the State, occupied by Cretaceous and Tertiary formations. The physiographic matter is contributed by Haworth; the geological descriptions by Prosser and Logan. The Tertiary lies unconformably on the broadly eroded Cretaceous. The surface of the latter, north of the Arkansas and west of the paleozoic area, presents three ragged east-facing escarpments of moderate height at the margins of the Dakota sandstone, Benton limestone and Fort Hays limestone, with intervening plains gradually ascending west-

ward. The Tertiary, mostly composed of sands and gravels, hundreds of feet in thickness, derived from the Rocky mountains, is explained chiefly as river wash, and not as a lacustrine deposit. Its eastward margin is marked by an irregular escarpment formed on the 'mortar beds' (sand or gravel with calcareous cement). Its general surface, away from the river valleys, is broadly even. Faint depressions or swales occur, holding water for a month or so in the year; they are ascribed to unequal settling of the strata, followed by underground leaching. A further stage of this process is seen in the 'arroyos,' slight depressions of the surface with continuous descent, like stream channels, but broad, grassy and flat, with low bluff-like rims up to their very heads.

The uplands with their escarpments are much dissected by the rivers, giving local relief of 250 or 300 feet, and a greater variety of scenery than is commonly associated with the Great Plains; yet it seems something of an exaggeration to say of this treeless region that "near any of the drainage streams one almost invariably finds a varied and pleasing landscape which in many respects is rarely surpassed in America." Even some of the larger rivers are of inconstant flow; for example, the Cimarron river 'has water in it throughout the greater part of the year in most of its course.' Bear and White Woman creeks, one south, the other north of the Arkansas, enter the State from Colorado in well-cut valleys, and after heavy rains possess a large volume of water with much sediment; but their valley sides decrease in height down stream, and at last the waters and sediments are spread out on the even uplands or lost in the sand hills, without joining any other river. Smoky Hill river is working on bed rock for much of its course; but the Arkansas has heavily aggraded its valley. The report is illustrated with a number of photographs, whose value would have been greater had they been taken when possible from higher points of view. The last of a number of plates gives a bird's-eye view of the State, with geological areas, rivers, and county boundaries marked on the surface and vertical sections on the margin, of much service in elucidating the text.

BELL ON CANADIAN RIVERS.

Robert Bell, of the Canadian Geological Survey, discusses the 'Evidences of northeasterly differential rising of the land along Bell river' (Bull. Geol. Soc. Amer., VIII., 1897, 241–250), which flows northward from the upper Ottawa to Hudson Bay. Good proof is given that the upper Ottawa crossed the present height of land in postglacial time and followed the Bell; and that its diversion to the St. Lawrence is due to a rise of the land in the north or northeast still in progress. Some of the ragged expansions of the rivers, forming lakes, which are commonly explained as the result of drift barriers, are ascribed by Bell to backwater flooding in consequence of the tilting of the land. The small relief of the region and the low divides between the rivers, combined with the resistant character of the ledges where crossed by streams, are all favorable to these results. The Bell river, flowing towards Hudson Bay, has acquired a low-grade course through a clay-covered lowland of till; it is here and there interrupted by rapids on hard ledges. At present the water becomes deeper (even thirty or forty feet), the stream broader, and the banks less defined in going up stream from from one fall to the next; and this is well interpreted as a result of uplift in the north. The out-branching 'lost channels' of various east- or west-flowing rivers are generally found on the south side of the main stream. The Churchill River seems to be on the verge of spilling over south-

ward at Frog portage, 500 miles from its mouth, and running to the Nelson. Altogether, this is a most interesting and valuable contribution to the natural history of rivers.

THE PLATEAU OF WEST VIRGINIA.

A REPORT by M. R. Campbell and W. C. Mendenhall, dealing primarily with the 'Geologic section along the New and Kanawha rivers in West Virginia' (17th Ann. Rep. U. S. G. S., Pt. II., 1896, 479–511), includes a brief account of the physiography of the plateau thereabouts, with a number of excellent illustrations from well selected points of view. The river canyon, for such it truly is in spite of its occurrence east of the 100th meridian, is a full thousand feet deep, with forested walls descending at angles of 35° or 40° to a narrow valley floor. Where the river cuts down upon harder sandstones it has not yet developed a graded channel; elsewhere it has narrow belts of flood plain, now on this side, now on that. The canyon is sharply cut in a Tertiary peneplain that was well smoothed for a number of miles on either side of the river, but further away the upland is interrupted by knobs and ridges that rise distinctly above it. The dissection of the peneplain was permitted by a broad arching uplift late in Eocene time, its present altitude being 2,600 feet near Hinton, but of less amount to the southeast and northwest. The river fortunately maintained its antecedent course across the broad arch, and thus opened the important highway through a region that would otherwise be difficult to traverse. Agriculture has lost much in the conversion of the smooth peneplain into a dissected plateau, but mining has made corresponding gains in the exposure given to numerous coal beds on the valley sides.

CRATER LAKE AND MT. MAZAMA, OREGON.

AN account of Crater Lake, by Diller (Amer. Journ. Sci., III., 1897, 165–172) notes that the Mazamas, a society of mountain-climbers of Portland, met at the lake last summer and gave their name to the vanished cone, now replaced by the superb caldera. So far as I know, this is the first instance of giving a special name to a vanished volcano, although the habit of naming extinct lakes is now common. Besides the evidence from truncated lava beds and headless valleys, which points so unequivocally to the loss of the Mazama cone, Diller adds evidence from glaciation. Not only are there moraines in the valleys two to five miles down from the river, but the topmost rocks of the rim are planed off and striated on the outer slope, while the cliffs turned toward the lake have angular and broken faces. The ice, therefore, came from a higher source than any now present, and, judging by the extent of the glaciation, Mazama was in the glacial period a rival of Shasta and Rainier for the supremacy of the range. It was still active during the presence of the ice; for on the northeastern rim a glaciated lava flow covers two layers of pumice separated by a sheet of rhyolite, and all these lie on an older glaciated surface. It is suggested that the heavy deposits of waste that occupy the lower radial valleys were washed down by floods that were caused by eruptions from the snow-capped mountain. The caldera is explained by the withdrawal of the deep lavas, followed by a great cave-in of the upper cone. An edition of the Crater lake topographical sheet, published by the Geological Survey, has been printed with a number of excellent photographic views on the back.

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CURRENT NOTES ON ANTHROPOLOGY.

MAN AND HIS ENVIRONMENT.

Two of the lectures at the National Museum, reprinted in the last Smithsonian Re-

port, are on man and his environment. Major J. W. Powell addressed his audience on the 'Relation of Primitive Peoples to Environment, Illustrated by American Examples,' while Professor O. T. Mason chose as his topic 'The Influence of Environment upon Human Industries or Arts.'

It is needless to say that both lectures are learned and instructive. Major Powell explains the origin of the activities of culture and their modification by the qualities and properties of external existences. He refers to those forms of environment which appear as institutions, opinions and languages, and weighs their values.

Professor Mason begins with man's cosmic environment and its influence on his industrial activities, and devotes his chief attention to the especially American environments and their association with aboriginal industries. The table which he presents in this connection is clear, full and suggestive.

There is no question of the high value of such thoughtful contributions as these to the science of man. But sometimes there is a danger that man himself may be lost to sight in the contemplation of his surroundings. Forty years ago Draper and Buckle saw nothing in man but a creature of environment; whereas, to-day, the highest note of anthropologic science is to chant the victory of man over his environment by the powers of his psychical nature.

SLAVERY OF THE AMERICAN INDIANS.

In the study of native American ethnography the question of human slavery has important bearings. Before the discovery, it prevailed in Mexico and northern South America, perhaps on the northwest coast. The Spanish adventurers did not hesitate a moment to enslave the Indians, but neither the monarchs of Spain nor the Catholic clergy authorized such proceedings. The latter, indeed, notably Father Montesinos and the famous Las Casas, protested against it in the strongest terms, as has been again shown by Dr. Marc F. Vallette, in his 'Studies in American History.'

An article on 'Canadian Indian Slavery in the Eighteenth Century,' in the *Proceedings* of the Canadian Institute, February, 1897, by Dr. James B. Hamilton, proves that Indian slaves were quite numerous there until within the present century, and, according to the Abbé Tanguay, were found also among the Catholic population. They bore the name *Panis*, that is, Pawnees; as it seems that members of this tribe were captured by the Algonkins and sold to the early traders, whence all enslaved Indians came to be so called.

None of the northern tribes, however, was successfully reduced to a state of bondage, and this accounts largely for their destruction as a race.

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NOTES ON INORGANIC CHEMISTRY.

At the conversazione of the Royal Society, May 19th, among interesting exhibits was one by C. T. Heycock and F. H. Neville of a curious alloy of silver and zinc, "which would have warmed the hearts of the old-time alchemists." This alloy is of the ordinary color of silver, but when warmed up to 300° C. and then suddenly cooled it becomes the color of copper. On reheating and cooling slowly it resumes its original color. The same effect is produced by heating in air, in hydrogen or in a vacuum.

The *Chemical News* quotes from the Sanitary Chronicles of the parish of St. Marylebone, for the month ending March 31, 1897, the reports of work done by Dr. Winter Blythe on the disinfecting properties of formaldehyde, commonly known in solution as formalin. One part in ten thousand suf-

fices to preserve milk, soup and similar articles for a considerable time. The aqueous solution, when exposed in dishes, has a tendency to polymerize, its disinfecting qualities becoming by this much impaired. It is as a gas that formaldehyde exercises its valuable properties most efficiently. A comparative trial was made with sulfur dioxid and formaldehyde in two rooms in which various bacilli were exposed. The growth of the typhoid bacillus and the anthrax bacillus were not prevented by sulfur dioxid, but were by formaldehyde. The fumes of formaldehyde are very irritating to the eyes, but in general are far less disagreeable than those of burning sulfur. In conclusion, Dr. Blythe considers that formaldehyde is superior to sulfur dioxid as a disinfectant, and recommends its adoption by the vestry of the parish.

OBSERVATIONS appear to show that the proportion of argon in exhaled air is slightly less than that in inhaled (1.21% as against 1.186%). It had been suggested as possible that argon formed a compound with the hemoglobin of the blood. This seemed the more probable from the fact that when analyzed by the Kjeldahl method, where the nitrogen is converted into ammonia, the amount of nitrogen obtained from hemin is less than that by the Dumas method, where the nitrogen is measured absolutely. In the last *Berichte* J. Zaleski, of St. Petersburg, describes careful examination of preparations of the coloring matter of the blood for argon, but in no case was a trace of argon found, so that some other explanation must be sought for the analytical differences.

THE constitution of phosphorous acid has been a matter of doubt, for though much evidence points to $OPH.(OH)_3$ its formation by the action of water on PCl_3 points to $P(OH)_3$. The ester $P(OC_2H_5)_3$ is known, being formed, however, not from the acid, but by action of $Na(OC_2H_5)_3$ on PCl_3. Michaelis and Becker describe in the last *Berichte* the formation of an isomeric ethyl ester directly from phosphorous acid by the successive action of lead acetate, giving lead phosphite; ethyl iodid, giving diethyl phosphorous ester; metallic sodium, replacing the hydrogen atom, and ethyl iodid, giving $OPC_2H_5.(OC_2H_5)_2$, the diethyl ester of ethyl phosphinic acid, a compound differing materially from its above mentioned isomer $P(OC_2H_5)_3$. From this it appears very probable that the true constitution of phosphorous acid is $OPH.(OH)_3$ with quintivalent phosphorus, and not $P(OH)_3$, with the phosphorus atom trivalent. Reasoning from analogy the constitution of hypophosphorous acid would be $OPH_2.OH$, which has long seemed probable.

DISCUSSION has been carried on in the *Berichte* between Dr. Emmerling, of Charlottenburg, and Dr. Gosio, of Rome, as to the cause of poisoning from fabrics, as carpets and wall papers, containing arsenic. Several moulds are known to flourish on media containing solid compounds of arsenic, among them *mucor mucedo* and *aspergillus glaucus*. In *penicillium brevicaule* Dr. Gosio finds a mould which, grown on a medium containing arsenic, evolves a volatile substance with the characteristic garlic odor of volatile arsenic compounds, and which was instantly fatal to a mouse. The nature of this compound is, however, undetermined, and Dr. Emmerling doubts its existence. His doubts are based on the fact that he has obtained no evidence of its existence, using the *mucor* and the *aspergillus*, though he has not experimented with the *penicillium*. It is to be hoped that others will succeed in obtaining the volatile arsenic compound if it really exists, and settle finally this long controverted point in toxicology.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

EFFORTS are being made to collect $50,000 to purchase for the Philadelphia Academy of Natural Science the paleontological collections of the late Professor Cope. The sum of about $5,000 has been already received. It would be especially appropriate that these collections should be secured by the Academy, where the proceeds of the sale will be used for the foundation of a chair of paleontology.

A BRONZE bust of Maria Mitchell has been unveiled in the Observatory at Vassar College. It was cast by the Gorham Silver Company from a plaster bust made in 1877 by Miss Mary Brigham.

DR. JAMES HALL, the Geologist of the State of New York, is to sail for Europe on June 24th, to attend the coming meeting of the International Geological Congress at St. Petersburg as a representative of the State.

LORD LISTER and Professor Max Müller have been elected members of the Imperial Academy of Sciences of Vienna.

DR. EDUARDO WILD, formerly Minister of Justice and Minister of the Interior of the Argentine government and now professor in the Buenos Ayres University, is in the United States as part of an extended tour with the object of investigating educational institutions.

MR. FREDERICK L. RANSOME has been appointed Assistant Geologist in the U. S. Geological Survey.

A MEMORIAL to Joseph Thomson, the African explorer, was unveiled at his birth place, Thornhill, near Dumfries, Scotland, on June 8th. The memorial consists of a pedestal with basreliefs and a bust in bronze of Thomson executed by Mr. Charles McBride. It is proposed further to present a repliqua of the bust in marble to the Royal Geographical Society.

A COMMEMORATIVE tablet to the eminent French botanist Duchartre was, on May 23d, placed on the house at Portiragnes, where he was born in 1806.

THE Epidemiological Society of London has collected funds for a Jenner medal, the design for which has been entrusted to Mr. Allen Wyon.

KARL REMIGIUS FRESENIUS, the eminent chemist, died at Wiesbaden on June 10th. He was born at Frankfort-on-the-Main in 1818, and had been, since 1845, professor of chemistry in the Agricultural Institute at Baden.

MR. ALVAN G. CLARK died at Cambridge on June 9th, aged sixty-four years. Astronomy is deeply indebted to the senior Alvan Clark, who died in 1887, and to his two sons. In 1859 Mr. Clark began the making of an object glass eighteen and one-half inches in aperture, the largest that had up to that time been attempted. In 1873 the firm made the twenty-six-inch objective for the observatory at Washington, and in 1880 the thirty-inch refractor for the Imperial Observatory at St. Petersburg. These were followed by the thirty-six-inch lens of the Lick Observatory and the recently completed forty-inch lens for the Yerkes Observatory. The making of such lenses was a scientific work of the utmost value, and Mr. Clark had also made direct contributions to astronomy, including the discovery of the companion of Sirius in 1862, for which he was awarded the Lalande Medal of the Paris Academy.

WE also regret the following deaths: Dr. William Thompson Lusk, President and professor of gynæcology in the Bellevue Hospital Medical College, New York, and the author of many important contributions on gynæcology, died on June 12th. Mr. Richard Christopher Rapier, an eminent British engineer, died on May 28th, aged 61 years. Mr. Ney Elias, who made important geographical explorations in Asia, died on May 21st. Privy Councillor von Falke, formerly Director of the Austrian Museum of Art and Industry, died on June 19th, aged 72 years.

GINN & CO. make the important announcement that they will publish in the course of the present month the first number of *The Zoological Bulletin*, a companion serial to the *Journal of Morphology*, designated for shorter contributions in animal morphology and general biology, with no illustrations beyond text-figures. It is to be expected that there will be sufficient material for at least six numbers a year of about fifty pages each, form and style to be the same as the *Journal of Morphology*, so that articles in whole or in part can be easily

transferred in case of need. The *Journal* will be edited by Professors C. O. Whitman and W. M. Wheeler, of the University of Chicago.

Natural Science completes its tenth volume with the current number, and will hereafter be published by J. M. Dent & Co., London. *Natural Science* has undertaken the somewhat difficult task of publishing each month an extended series of anonymous editorial notes and comments. These have always been independent and interesting; indeed, the journal throughout has demonstrated that science need not be dull. *Natural Science* has given more space and more intelligent appreciation to the results of American science than any other foreign journal, and should have a large circulation in the United States.

IN addition to the parties under Prince Luigi Amadio and Mr. Henry G. Bryant, now attempting the ascent of Mt. St. Elias, we are informed that a party from the London Alpine Club and the Boston Appalachian Mountain Club will carry out explorations in the Canadian Alps, with special reference to the snowfield of the Continental Divide.

PROFESSOR WILLIAM LIBBEY, with a party from Princeton University, expects to explore during July a mesa or sandstone table land near Albuquerque, N. Mex. The mesa rises from the plains to a height of more than 7,000 feet and has hitherto proved inaccessible, although it is thought to contain archæological remains.

PROFESSOR GEORGE H. BARTON finds that he is unable to accompany Lieutenant Peary this summer, and the expedition will not include the party from the Massachusetts Institute of Technology.

THE steamship *Windward* has left London for Franz Josef Land in order to bring home the members of the Jackson-Harmsworth expedition, who have now spent three winters near Cape Flora. The steamship takes with it special stores to be left at Elmwood, in case Dr. Andrée should be compelled to seek safe quarters in Franz Josef Land.

ACCORDING to Reuter's Agency, Captain Sverdrup has abandoned his original intention of exploring this year the unknown tract between Franz Josef Land and Spitzbergen. His plan now is to go up to Smith Sound, advancing along the northwestern part of the coast of Greenland, and to spend the winter in exploring on sledges that country and the American side of the North Pole generally, thus supplementing the *Fram's* exploration of the Asiatic and European side. It is understood that Professor Mohn and Dr. Nansen approve the plan, for which an appropriation of 20,000 kroner has been asked from the State funds, the rest having been subscribed privately.

THE daily papers report, how correctly it is not possible to state, that Mr. F. W. Christian has returned to Sydney after two years spent in exploration in the South Sea Islands, having discovered ancient records, hand work and weapons that prove that the Asiatic races traded in the Islands, and that the ancient Chinese immigrated and colonized there and thus reached Central America.

MR. FREDERICK H. BLODGETT, Secretary of the New Jersey State Microscopical Society, writes us that the twenty-eighth annual meeting of the Society was of special interest. After some opening remarks by the President, Dr. J. Nelson, Dr. H. C. VanDyck explained his projection microscope for polarized light, and a series of slides was exhibited by Dr. A. H. Chester. A large number of table exhibits was shown by members of the Society.

AMERICAN physiologists, attending the meeting of the British Association at Toronto, should not fail also to be present at the Montreal meeting of the British Medical Association, which opens on September 1st. The subjects taken up for special consideration by the Section for Anatomy and Physiology are: Anæsthetics, the Teaching of Anatomy and the Causes and Modifications of Heart-beat. The President of the Section is Dr. Augustus Waller, London; the Vice-Presidents are: Drs. F. Shepherd, Montreal; T. Wesley Mills, Montreal; A. B. McCallum, Toronto; A. Primrose, Toronto, and J. B. A. Lamarche, Montreal. The Honorary Secretaries are: Drs. Robert Hutchison, J. M. Elder and W. S. Morrow.

THE thirty-fifth University Convocation of the State of New York will be held in Albany on June 28th, 29th and 30th. The subjects selected

for special discussion include science teaching, in which Professor W. M. Davis and Professor Geo. F. Atkinson will take part, and the American University with special reference to a National University at Washington.

Governor Black has signed the bill appropriating $126,600 for the enlargement of the buildings of the Craig colony for epileptics.

The new tunnel under the Thames at the East End of London, constructed under the auspices of the County Council, was opened on May 22d.

The *American Naturalist* states that Drs. Maxwell and Swan, of Monmouth College, Illinois, propose to organize a summer school of biology, which will be probably located on the Mississippi River, not far from Monmouth.

It is said that a bill has been introduced in the Minnesota Legislature providing for the appointment of expert witnesses, and that the homeopathic physicians have, with legal advice, prepared a bill to be presented to the New York Legislature. The object of the bill is to provide a list of experts from whom witnesses are to be selected by the Court and paid by the State. The employment of expert witnesses by the counsel for the prosecution or defence has been unfortunate both for the Courts and for science. It would certainly be desirable to devise a plan by which the expert witness should be in the position of a judge rather than that of a paid attorney.

The unfortunate relations of politics to science are illustrated by the following note from the New York *Tribune*: "Senator Elkins and Representative Dovener, of West Virginia, had a talk with the President about West Virginians. They introduced George Bowers, a candidate for Fish Commissioner, and Alexander Campbell, who wants a Deputy Auditorship. It is stated that there are numerous applicants for Fish Commissioner, but at the same time it is stated that Commissioner Brice stands well at the White House. Many prominent Republicans have requested that he be retained, and have pointed to his services as having been decidedly satisfactory. It is hinted that the President will make no change, if at all, without giving thorough consideration to the idea of retaining Mr. Brice."

The United States Civil Service Commission announces that it will hold a special examination on July 28th for establishing a register from which appointment may be made to the position of Assistant Chief in the Division of Soils in the Agricultural Department. The salary of this position is $1,800 per annum and men only are eligible. All applicants are required to submit to the Commission, not later than July 15th, an original essay, either printed or in manuscript form, consisting of not less than 5,000 words and containing a thorough treatment of the subject 'Environment as affecting the yield, quality and time of ripening of crops.' This paper should fully cover the relation of climate, soil and other conditions to the functions of plants, with special reference to the commercial aspect of the subject. Only those applicants who submit satisfactory essays will be admitted to the remainder of the examination, which will be held on July 28th. The subjects and relative weights of the examination will be as follows:

Plant physiology	3
Climatology	2
Soils	2
Crops (including production and marketing)	2
Languages, German and French, (Translated into English)	1
Essay	10
Total	20

All persons desiring to compete in this examination should write at once to the United States Civil Service Commission at Washington, D. C., for blanks and further instructions.

Dr. H. Carrington Bolton recently called the attention of our readers to a patent allowed by the British office for making gold. An application for a patent to convert baser metals into gold has been made to our patent office, but it appears that the Treasury Department undertook to test the process and that the patent has so far been withheld.

We learn from the London *Times* that the Select Committee of the House of Commons appointed to inquire into the administration of the museums of the Science and Art Depart-

ment has presented an interim report calling attention to the peril of destruction by fire to which the priceless collections at the South Kensington Museum are exposed. After describing the general character of the buildings and their inflammable structure, the report goes on to observe that the reason why the structural alterations necessary for the protection of the collections from fire have not been made appears to be that the completion of the permanent buildings has always been in the contemplation of successive governments, and the committee regard it as their immediate duty to lay before the House of Commons their very strong opinion that permanent buildings for the adequate accommodation of the collections at South Kensington should be proceeded with without delay.

A THIRD exhibition of recent geological work was opened on June 1st at the Paris Museum of Natural History. The *Times* states that England contributes some geological charts and India some meteorites. M. Schuck sends specimens of Transvaal auriferous rocks; M. le-Feuvre, Chilian nitrates; M. Chaefanjon, Central Asian rocks and Chinese coal; M. Chauvau, Madagascar gold ore, and the Dutch government a large geological chart of Java.

THERE will be held at Berlin in October an International Congress on Leprosy, to which the United States Department of State has been invited to send delegates.

THE daily papers report that the movable floor of the great dome of Yerkes Observatory fell 45 feet on May 29th. The damage is confined to the floor and the machinery immediately connected with it. The cause of the accident has not yet been announced.

IN view of the 20th annual convention of the National Electric Light Association, which opened on June 8th at Niagara Falls, the *Electrical World* gives an elaborately illustrated review of the electrical installation of the Falls. The total horse power of the Falls is estimated at about 2,500,000, of which about 52,000 will be required for the present installation. This will lower the level of the Falls by about two inches. At the present time the electro-chemical industries use 11,000 horse power, of which the most important are those for the manufacture of aluminium, carborundum, sodium and calcium carbide.

WE learn from *Natural Science* that a large addition is being made to the Bergen Museum. To the cost, which will exceed $40,000, the Norwegian government has contributed half, while smaller sums have been given by the municipality of Bergen and by private persons. The number of visitors to the museum was over 50,000 in 1896.

A LABORATORY of experimental phonetics has been established under the chair of comparative philosophy of the Collège de France.

THE new Medical School buildings of Guy's Hospital, London, were recently opened by the Prince of Wales. The Treasurer stated that nearly $500,000 had already been received for the endowment fund of the hospital in answer to the appeal of the Prince of Wales.

WITH the concurrence of the Astronomer Royal, a site has been fixed in Greenwich Park for the new magnetic observatory.

IN a notice of Mr. J. B. Leiberg's report of his botanical survey of the Coeur d'Alene mountains, Idaho, in the summer of 1895 (Contrib. U. S. Natl. Herb., Vol. V., No. 1), in the current number of the *American Naturalist*, Dr. Bessey remarks: "It is interesting to note that, in spite of the fact that this report has a marked economic flavor, all measurements are metric throughout. Certainly if the United States Department of Agriculture can safely use the metric measurements in a bulletin dealing with topography, drainage, climate, mineral deposits, agricultural capacity, agricultural products, grazing lands, native food plants, utilization of water supply, forest resources, forest destruction, forest preservation, etc., botanists need no longer fear to make use of such measurements in their books, even of the most popular character."

INVESTIGATIONS by Tangl, of Budapest, which are reported on in *Pflüger's Archiv*, are of interest to those who have the management of horses. He finds that digestion proceeds more rapidly in the horse if eating is followed by active exercise than if it is followed by a period of rest. This is the opposite of what

takes place in the dog and in man, but the difference need not occasion surprise, in view of the difference in food and habits.

M. Moissan reported to the Paris Academy of Sciences on May 31st that, in conjunction with Professor Dewar, he had succeeded in liquefying fluorine.

We learn from *Nature* that the British Board of Agriculture has issued an order which prohibits the importation of dogs into Great Britain from any other country (except Ireland and the Isle of Man) otherwise than in accordance with certain provisions set forth. The order takes effect on September 15, 1897. After that date no dog may be landed in Great Britain from any other country without a license from the Board of Agriculture, application for which is to be made to the Secretary of the Board.

The maps of the Orinoco-Essequibo region of South America compiled for the use of the Venezuela Boundary Commission have been published in atlas form. There are seventy-six maps in all, of which fifteen are new and made especially for the Commission's use, while the remaining sixty-one are fac-simile reproductions of old ones selected from the large number brought to the attention of the Commission.

An Association of Teachers of Science in Indiana was organized in 1896, and held its second meeting at Lafayette on February 26th and 27th. We learn from the *Inland Educator* that a committee consisting of Professor D. W. Dennis, Richmond, Ind.; Professor Dumont Latz, South Bend, Ind.; Professor M. B. Thomas, Crawfordsville, Ind.; Professor J. T. Scovel, Terre Haute, Ind., and Professor G. A. Abbott, Evansville, Ind., was appointed by the Association to investigate the questions discussed and report a course of science study for the high schools of the State. The questions before the committee are: What subjects should constitute a science course? How much time should be given to each? In what order should they be considered? How much laboratory work should be required? etc. The committee would be glad to hear from every science teacher and interested school official in the State in regard to these and kindred questions.

Natural Science states that Mr. A. Gibb Maitland, late of the Geological Survey of Queensland, has been appointed Government Geologist of West Australia, and is reorganizing the staff with the view of making a proper geological survey of the mining fields of the colony and publishing maps of the same. As a preliminary to this a typographical survey is being prepared with the assistance of a topographer. Mr. Torrington Blatchford, of the Sydney School of Mines, who has had much practical experience of mining geology, has been added to the staff. Applications have also been invited by the government for the position of Assistant Geologist; while as Mineralogist and Assayer there has been appointed Mr. Simpson of the Sydney School of Mines, late Chief Assistant Assayer to the Mount Morgan Co., Queensland.

UNIVERSITY AND EDUCATIONAL NEWS.

Five additional fellowships have been established at the University of Pennsylvania on the Harrison Foundation. The University now offers nineteen fellowships of the annual value of $500 each and five senior fellowships of the value of $800.

The Lawrence Scientific School of Harvard University receives $5,000 by the will of the late Miss Edith Rotch, of Boston.

A memorial scholarship of the value of $8,000 has been given to Vassar College by Mrs. Ann Shepard, of Brooklyn.

Mr. H. A. Morgan, of the Board of Trustees of Wells College, has given the College $30,000, covering the debt on the rebuilding of the main building in 1890.

The Trustees of Syracuse University have contributed $32,000 to cover the deficit in current expenses, half of this amount being given by Mr. Jno. D. Archbold, President of the Board.

The naval authorities have decided to establish a post-graduate course at the Naval Academy for cadets intended for the construction corps, and orders have been issued directing Assistant Constructor Hobson to report for duty at the head of the department.

The catalogue of the University of Minnesota for the year 1896 shows that there was at the University an attendance of 2,647 students, of which number 728 were women. There were 156

students in the graduate departments, 909 in the College of Science, Literature and the Arts, and 181 in the College of Engineering, Metallurgy and the Mechanic Arts. 307 degrees were conferred at the commencement exercises on June 3d.

OF the £30,000 immediately required towards the endowment fund of the new Sheffield University College £24,000 has already been subscribed.

DR. A. HILL, Master of Downing College and lecturer on human anatomy, has been elected Vice-Chancellor of Cambridge University for the coming year.

AT Columbia University Mr Herbert M. Richards has been appointed tutor in botany; Dr. James Ewing, instructor in clinical microscopy; Dr. Charles Norris, tutor in pathology; Mr. Benjamin Jakish, assistant in chemistry; Mr. William E. Day, assistant in physics, and Mr. James H. McGregor, assistant in zoology.

AT the Teachers' College, New York, Mr. Richard E. Dodge has been promoted to a professorship of geography, and Mr. C. E. Bickle to an associate professorship of mathematics.

DR. CHARLES ST. JOHN, of the University of Michigan, has been made professor of physics at Oberlin College.

PROFESSOR WILLIAM A. ROGERS has resigned from the chair of physics and astronomy at Colby University, and it is reported that he has accepted a professorship of physics at Alfred University.

DISCUSSION AND CORRESPONDENCE.

THE DISTRIBUTION OF MARINE MAMMALS.

TO THE EDITOR OF SCIENCE: The interesting memoir of Dr. P. L. Sclater 'on the Distribution of Marine Mammals' (SCIENCE, V., 741–748) ignores previous investigators, and the general reader might, therefore, receive the idea that the subject under consideration has been entirely neglected by other writers, and would be also liable to suppose that his 'six sea-regions' were of equal value. In both postulates he would be entirely mistaken. The bearings of marine mammals on zoogeography and the differentiation of the 'regions' into primary and secondary ones have been frequently considered by others.

Dr. Sclater considers that, "for the geography of marine mammals, the ocean may be most conveniently divided into six sea-regions, which are as follows:"

'I. *Regio Arctatlantica.*'
'II. " *Mesatlantica.*'
'III. " *Indopelagica.*'
'IV. " *Arctirenica.*'
'V. " *Mesirenica.*'
'VI. " *Notopelagica.*'

The characteristic types of each of these regions are named, but Dr. Sclater has evidently overlooked some sources of information and hence has unduly restricted certain forms. Thus, the *Balæna mysticetus* is by no means 'peculiar to Arctatlantis,' but has been the object of an extensive fishery north of Bering strait.* Nor are *Delphinapterus* and *Monodon* 'not found elsewhere,' for they also occur in Arctirenia. Further, *Berardius* is not restricted to the Notopelagian area, for a species occurs in the North Pacific.† It follows that these extensions of the ranges of the several genera diminishes the value of the regions supposed to be distinguished by their exclusive possession. If we have regard for the most characteristic aggregates of sea mammals, we are led to three primary divisions, viz:

Arctalian realm.	I.	Regio Arctalantica.
	IV.	" Arctirenica.
Tropicalian realm.	II.	" Mesatlantica.
	III.	" Indopelagica.
	V.	" Mesirenica.
Notalian realm.	VI.	" Notopelagica.

The Arctalian realm is characteristic from the development of the Phocine Phocids, the Odobænids or 'Trichechidæ' and the Delphinapterine Delphinids. The North Atlantic and North Pacific 'sea-regions' are distinguished from each other by features of much inferior importance.

The Tropicalian realm is remarkable for the development of the existing Sirenians and likewise of numerous Delphinine Del-

*See Dall in SCIENCE (n. s.), V., 843, May 28, 1897.

†Berardius Bairdii Stejneger, Proc. U. S. Nat. Mus., VI., 75, 1883.

phinids, and it is also the home of Phocids more nearly related to the Phocines than the Lobodontines (though often associated with the later), but of a more generalized type than either and probably entitled to subfamily distinction—the Monachinæ. The subdivisions of this realm, so far as the marine cetaceans are concerned, are of very subordinate importance, and the restrictions of the Monachine seals and different families of Sirenians are the most noteworthy characteristics.

The Notalian realm is specialized by the development therein of a peculiar subfamily of seals—the Lobodontine Phocids.

These three realms were distinguished as early as 1875 and named in 1877.* They are well fitted for the expression of the facts of distribution of the marine mammals, but for those respecting other classes two transition realms appear to be advisable—the Pararctalian and Antarctalian, and doubtless two others—the Pelagalian and Bassalian—should also be recognized. If the last are adopted most of the cetaceans should rather be relegated to the Pelagalian realm. I venture to add the opinion that the realms thus advocated are much better comparable with Dr. Sclater's land-regions than are his own sea-regions.

THEO. GILL.

MR. T. L. SCLATER, in his very interesting paper, 'On the Distribution of Marine Mammals' (SCIENCE, May 14, 1897), makes the following remarks on the seals of the Galápagos (p. 742): "There are well founded traditions of eared seals having been formerly met with in the Galápagos, while they still occur on the coast of Peru and Chili."

Two species of seals are found on the Galápagos, as has been stated by J. A. Allen† in the extensive work on the North American Pinnipeds. *Otaria jubata* (Forster) and *Arctocephalus australis* (Zimmermann), of both specimens, have been collected by the Hassler expedition (1872), which are preserved in the Museum of Comparative Zoology, Cambridge, Mass.

Otaria jubata (Forster) is still quite common on the Galápagos. I have met it on Chatham, Charles, Hood, Gardner, Barrington, South Albemarle, Duncan, Jervis and James. They are found in considerable numbers, especially on Hood and Gardner, Barrington and Duncan. On the latter some of the rocks, where they move about, are polished absolutely smooth.

I have not seen any specimens of *Arctocephalus australis* (Zimmermann), but whether they are extinct or not I do not dare to say.

The presence of *Sphenicus mendiculus* (Sundevall), a penguin peculiar for the Galápagos is interesting.

The most extensive data on the seals of the Galápagos and the seals of the South Pacific and Antarctic Ocean are given by Benjamin Morrell (a narrative of four voyages to the South Sea and South Pacific Ocean, Indian and Antarctic Ocean from 1822 to 1831. 8°. New York, 1832).*

The seals have been mentioned already by the first discoverer of the Galápagos, Fray Tomás de Berlanga,† obispo (bishop) de Castilla del Oro, on the 10th of March, 1535. He had the order from the Emperor Charles V. to report on the government of Pizarro and to write a description of Peru. The 23d of February, 1535, he sailed from Panama. For seven days the wind was favorable, but after that a calm set in for eight days and the very strong currents drifted the vessel far out to the sea. The 10th of March they sighted an island and, having only water for two days more, they anchored to look for water and fodder for the horses. There they found nothing but seals, sea-turtles and land tortoises so big that each could bear a man on its back, and many iguanas, which are like snakes. ("No hallaron sino lobos marinos y tortugas y galápagos tan grandes, que llevable

*See SCIENCE (n. s.), III., 515, 1896.

†Allen, Joel Asaph: History of North American Pinnipeds; A Monograph of the Walruses, Sea-Lions, Sea-Bears and Seals of North America; U. S. Geolog. and Geogr. Surv. of the Territ.; F. V. Hayden, Geologist-in-Charge. Miscellaneous publications—No. 12, Washington, 1880, p. 208, 210–211, 367, 769–770.

*In 1823 he took in a period of two months about five thousand fur-seal skins (*Arctocephalus*) from the Galápagos.

† Marcos Jiménez de la Espada. Las Islas de los Galápagos y otras más poniente. Sociedat Geografica de Madrid. 1892. pp. 1–5.

cada uno un hombre encima, y muchas iguanas, que son como sierpes.") G. BAUR.

UNIVERSITY OF CHICAGO.

THE article of Mr. Sclater in SCIENCE, May 14th, on the distribution of the Seals, Sirenians and Cetaceans, disregards the more recent publications on zoogeography, especially marine zoogeography. It begins with a somewhat indefinite statement, that 'most of the recent writers on Geographical Distribution have confined their attention to terrestrial mammals, or, at any rate, have but casually alluded to the marine groups of that class.' I may be allowed to state that the deficiency of our knowledge of the distribution of marine animals induced me, nearly two years ago, to publish a book,* which is particularly intended to supply this lack. It seems, however, that Mr. Sclater never has seen this book. Mr. Sclater seems also to be unacquainted with many other writings on the same subject, published since Wallace. I mention only the names of A. Agassiz, G. Baur, T. N. Gill, Guenther, v. Ihering, J. Murray, Neumayr, Pfeffer, J. Walther. The natural consequences of this neglect are most evident.

I do not think it worth while to enter into a closer examination of the theoretical views of Mr. Sclater, since all these points have been discussed by myself and others so extensively that anybody who has followed these discussions will see at once that his theoretical views are far from being in conformity with current theories. I shall state, however, a few points in the article referred to, by which it is proved conclusively that he did not consult most of the writers quoted above.

1. The term 'life-district' ('Lebensbezirk,' 'domaine biologique') seems to be completely unknown to Mr. Sclater; otherwise he would have treated the Cetaceans separately from the Seals and Sirenians. (Compare J. Walther, Ortmann, Chap. 3.)

2. The importance of the action of temperature-conditions has been completely overlooked by him; otherwise the effect of temperature should be shown in his sea-regions. (Compare Gill, Pfeffer, Ortmann, p. 37.)

3. The distinction of autochthonts, immigrants and relicts (compare Guenther, Ortmann, p. 34) is unknown to Mr. Sclater; otherwise he would have assigned a different value to the eared seals inhabiting the northern Pacific in comparison with the other seals; Phoca and Trichechus are autochthonts, while the Otariidæ are immigrants.

4. It is impossible to distinguish properly any distributional regions, which depend merely on a particular group of animals. The outcome will always be unsatisfactory. The regions created by Mr. Sclater are a striking evidence of the inconveniences of this method, as I have already pointed out in the beginning of Chap. 4 (p. 44–45) of my book. I mention only one instance: the fact that Trichechus and Phoca are found in the northern parts of both the Atlantic and Pacific Oceans is in no way represented in Mr. Sclater's division, although this fact is a very characteristic one, and, indeed, is the *rule* for the distribution of littoral polar animals. This rule is justified and supported by the physical conditions of the polar seas. Nevertheless, Mr. Sclater does not pay any attention to it, and frames his regions with regard to exceptional cases. (Compare eared seals, above, under 3.)

5. The definition of the Mid-Pacific Sea-region of Mr. Sclater is insufficient. In fact, he does not give any limits, nor any characteristics of this region.

6. The relations of his Indian Sea-region to his Mid-Atlantic Sea-region, due to the geological conditions of former times, and still exhibited in the distribution of the Sirenians, are not referred to at all, and of course no attempt has been made to explain them. (Compare Ortmann, p. 67 f.)

7. Mr. Sclater concludes that the distribution of the Otariidæ proves a connection of South America with Africa by land. I should suggest to him to read the papers of v. Ihering on this subject (Archhelenis), before he tries to bring the distribution of the eared seals in connection with this old continent. The old Archhelenis has positively nothing to do with the distribution of the sea lions; the latter are late Tertiary, while the Archhelenis was chiefly Mesozoic! The absence of any Otariidæ in the middle and northern Atlantic is exclusively due to temperature conditions.

*Grundzüge der marinen Tiergeographie, Jena, 1896.

8. In conclusion I should like to direct attention to the final statement of Mr. Sclater. Having made the (incorrect) supposition that the late-Tertiary group of the eared seals has been checked in its northward advance in the Atlantic by a connection of South America and Africa, he says that "all these facts, *with the one exception* of the supposed Atlantic barrier, would tend in favor of the *now generally accepted* doctrine that the principal masses of land and water are not of modern origin, but have existed mainly in their present shapes *throughout all ages.*" No less than three errors are contained in this single sentence, namely: 1. It is impossible to derive from the distribution of a group of Tertiary animals any conclusions as to the shapes of the principal continental masses *throughout all ages.* 2. This statement would hold for the Tertiary time only if we consider that the connection of South America and Africa, which is supposed by Mr. Sclater, is no important feature. Mr. Sclater admits that this Atlantic barrier forms an exception to the rule; but, I should say, such an exception throws the whole rule aside. 3. It may be that Mr. Sclater himself has accepted the 'doctrine' of the persistency of the continents, but I protest most vigorously against calling such a 'doctrine' *generally accepted.* A dogma (and this would be the proper name for it) that has been contradicted by students in zoogeography, such as Baur, Beddard, Neumayr, v. Ihering and others (and I should add, which is rejected by almost *all* geologists) cannot be regarded as 'generally accepted.'

The distribution of the Seals and Sirenians, it is true, has never been investigated from a scientific standpoint, but there are only a few distributional features which seem to be anomalous at first sight (Sirenia, Otariidæ), and even these may be explained readily. The Sirenia point to conditions existing in the beginning of the Tertiary period, and it is well known that this group existed in the Eocene epoch. The distribution of the Otariidæ is analogous to what has been called (improperly) 'bipolar' distribution. They represent the somewhat rare case of an Antarctic group of littoral animals which has crossed the tropics along the western coast of America and reached the northern Pacific. As to the latter fact I refer to a special paper published by me recently, which is especially devoted to this peculiarity of distribution.*

Arnold E. Ortmann.
Princeton University, June, 1897.

THE POTTER'S WHEEL IN AMERICA.

My neglect to mention the *Kabal*, pointed out in Mr. Mercer's letter (Science, p. 919), was not an oversight, but for two reasons: First, as he mentions, because the word with that meaning does not occur in the Maya dictionaries of the sixteenth century; and secondly, because the *Kabal* is not a potter's wheel in its results or in a technical sense.

This is shown in Mr. Mercer's own work, 'Hill Caves of Yucatan,' p. 77, where he quotes Captain Maler as saying that he 'had found no trace of the potter's wheel in the old specimens of pottery,' anywhere in Yucatan. Mr. Mercer brought no potsherds from ancient deposits to contradict this; and according to his own words the *Kabal*, as used to-day, does not give 'the regularity of outline' which is the artistic aim of the potter's wheel. (P. 164, note.)

D. G. Brinton.

SCIENTIFIC LITERATURE.

The Cambridge Natural History. Edited by S. F. Harmer, M.A., and A. E. Shipley, M.A. Vol. II., Flatworms, etc. Macmillan & Co. 1896. 8vo. Pp. xii+560, 257 figs.

Volume II. of the Cambridge Natural History, the third of the series to make its appearance, deals with those classes which are usually grouped together as Worms or Vermes, and Polyzoa. The different classes are treated by specialists whose names are familiar in connection with the subjects assigned to them. The work is shared by seven authors, as follows: Platyhelminthes and Mesozoa, by F.W. Gamble, pp. 1–96, Figs. 1–47; Nemertinea, by Lilian Sheldon, pp. 97–120, Figs. 48–61; Nemathelminthes and Chætognatha, by Arthur E. Shipley, pp. 121–194, Figs. 62–105; Rotifera, Gastrotricha and Kinorhyncha, by Marcus Hartog, pp. 195–238, Figs. 106–120; Archiannelida, Polychæta and Myzostomaria, by W. Blaxland Benham, pp. 239–344, Figs. 121–186; Oligo-

* Zool. Jahrb. Syst., Vol. 9, 1896, pp. 571–595.

chæta and Hirudinea, by F. E. Beddard, pp. 345–408, Figs. 187–210; Gephyrea and Phoronis, by Arthur E. Shipley, pp. 409–462, Figs. 211–231; Polyzoa, by Sidney F. Harmer, pp. 463–533, Figs. 232–257.

Fifty pages of Mr. Gamble's account are devoted to the Turbellaria, twenty-three pages to Trematodes, eighteen to the Cestodes and five to the Mesozoa, the major part dealing with the groups in which the author is most at home. A detailed description is given of the structure and habits of a common Polyclad (*Leptoplana tremellaris*) and a common Triclad (*Planaria lactea*), together with a general account of the different groups. It is to be regretted that the same method was not followed with the Rhabdocœles, with Mesostoma as the type, a cosmopolitan form, which has, perhaps, been the object of study more than any other Turbellarian. The account, on the whole, is the best that we have for the Turbellaria. But a few slips and inaccuracies occur, chief among them being the statement that land planarians are 'cylindrical,' and that "freshwater planarians vary from a quarter to half an inch in length," whereas it is known that among the common European species, *Dendrocœlum lacteum* (*Pl. lactea* of the author) reaches a length of 26 mm. (Iijima), *D. punctatum*, 5 cm. (Hallez), and *Pl. gonocephala*, 25 mm. Again, the 'sucker' of *Pl. lactea* is said to have been 'discovered by Leydig' instead of v. Baer or Dugés. Among the Rhadocœles no mention is made of the fact that certain members of the genus *Mesostoma* are viviparous, and of the relation between this condition and the occurrence of the thin-shelled 'summer eggs.'

The chapters dealing with the Trematodes and Cestodes are comparatively meagre, but are an excellent epitome of our knowledge of the parasitic flatworms. Structural matters are scarcely touched upon, the account consisting chiefly of life-histories, the life-history tables being novel and instructive. *Distomum magnum* is said (p. 4.) to be parasitic in sheep (!).

The Nemerteans are dismissed by Miss Sheldon in twenty pages, a small space for so important a group, particularly in the light of the extensive recent researches. The classification adopted is that of Hubrecht, although the more rational one of Bürger is printed, with the excuse that this author's work appeared too late to be adequately considered. One paragraph devoted to 'palæontology' tells us that Nemerteans 'are unknown in a fossil state.'

Mr. Shipley's chapters on the Nemathelminthes and Chætognatha are valuable compilations of the natural history of these orders, and the recent researches on the problematic Acanthocephala are here brought together for the first time. Synoptic tables are given of the species of Chætognatha, and Conant's list of American species finds a place in an appendix at the end of the volume.

In Professor Hartog's account of the Rotifera and their allies the most striking thing is the author's declaration of the relationships of the Rotifera with the lower Platyhelminths and his comparison of them with the *Pilidium* of the Nemerteans, the older idea of arthropod affinities being abandoned. A pleasing feature is a brief description of the technique for the preservation of Rotifers.

The most extensive section in the book comprises Dr. Benham's chapters on the Archiannelida, Polychæta and Myzostomaria. Under the second of these classes the general account is prefaced by a detailed description of a typical Polychæte (*Nereis pelagica*), as in Mr. Gamble's account of the Turbellaria. The classification employed is a modification of that proposed by by the author in 1894, according to which the various families are grouped under two 'branches' and seven 'sub-orders.' Following a general account of the structure and biology comes a systematic portion in which the various sub-orders are illustrated by descriptions of British species.

Mr. Beddard's account of the Oligochæta offers nothing new of importance, the chapter being an excellent summary of the general part of the author's recent monograph, and a good sketch of a group to our knowledge of which he has contributed so much.

The same author's chapter on the Hirudinea is not so carefully done as that on the earthworms, and at times is careless and almost flippant in its treatment. *Inter alia* we learn such bits of natural history as that "the former extensive use of the leech has led to the trans-

fer of its name to the doctor who employs it," and that "it has been suggested, however, that the term was applied rather by way of analogy." Again, in reading of the intelligence of the land-leeches of Ceylon we learn that "they may ascend herbs and shrubs to gain a better outlook when they are aware of an approaching footstep." The most valuable part of Mr. Beddard's account of the Hirudinea is his discussion of their relationships with the Oligochæta.

The chapters of Mr. Shipley on the Gephyrea and Phoronis are among the best in the book, and his treatment of the affinities of these troublesome forms is most full and impartial. The account also includes a table of genera and species.

The excellent final chapter by Mr. Harmer on the Polyzoa is restricted to British forms, and concludes with a detailed table for the determination of British genera.

As a whole, the work is to be most highly commended and is the best general account of 'worms' that has appeared. If the scope of the book had been somewhat more extended so as to include, in all classes, other than British forms, its value and usefulness would have been much enhanced. In criticism it can be said that the book is not altogether well balanced as to the space alloted to the different classes, and that a general introduction on affinities and classification in addition to the tables which precede the text would have been of value for the student. The illustrations, with a few exceptions, are of the highest order and include many new ones; as exceptions may be mentioned Figs. 8 and 14, which are little more than caricatures.

W. McM. Woodworth.

The Swastika. By Thomas Wilson. Washington, Government Printing Office. 1896.

This extensive monograph of about 250 pages, with 25 full plates and 374 figures in the text, is from the report of the National Museum for 1896. The author is the Curator of the Department of Prehistoric Archæology in the Museum, and well known to students in that branch. His subject is the hooked cross, that figure called in English the 'fylfot' (four footed), and in the East Indies, *swastika*. This the author, in his sub-title and throughout his volume, claims as 'the earliest known symbol,' and prepares to point out its 'migrations.'

The subject is by no means a new one, as Mr. Wilson's appended bibliography abundantly shows; but there have been so many explanations of the origin and significance of this figure, and so many claims made for it as of historic value in indicating early migrations or relations of tribes, that it was quite desirable that a calm survey and clear analysis of them should be made. Mr. Wilson, by his wide reading and acquaintance with prehistoric archæology, is eminently qualified to accomplish this task; but by reason of his general theories on the origins of culture has, it must be said, failed in his presentation.

Not that his volume lacks in thoroughness, or that it is not of very high value to anyone who would trace the prevalence of this figure in both the Old and the New World. In these respects the work is satisfying; it overflows with quotations, and is accurate and attractive in its numerous illustrations. But all this wealth of resource is, in the opinion of many close students of the topic, seriously injured by two hypotheses of the author which continually interfere with the accuracy of his perspective.

These are, first, that the *swastika* is always to be regarded as a symbol; and, secondly, that it 'migrated' from one or two centers and was in some sense a racial or ethnic figure.

Both of these hypotheses have been shown to be unquestionably erroneous by the latest researches in the decorative art of both hemispheres. The 'fylfot' in American, Polynesian and Asiatic art has been proved by Von den Steinen, Stolpe, Regnault and others to be as purely decorative as it is in modern wall paper. It has been found in Semitic and Egyptian art, whence scholars of Mr. Wilson's school have tried to exclude it. Like other simple linear figures, its origin is not single but multiple; and both as a picture and a symbol it has stood for widely diverse objects. The mysteriousness which has been thrown about it disappears on an examination of its origins and meanings in many different tribes wide apart in geographic location; and had the author of the volume before us, so excellent in many respects, sur-

veyed his vast aggregation of facts in their purely objective relations, we are sure he also would have reached this conclusion.

D. G. BRINTON.

L' Origine de la Nation Française. By PROFESSOR GABRIEL DE MORTILLET. Paris, Felix Alcan. 1 vol. Pp. 336. With 18 maps and 158 illustrations. Price 6 francs.

In this work Professor Mortillet means to begin at the beginning, so that he passes as merely modern the classical writers and even the dispersion of the Aryans, commencing his history of the French people about 230,000 years ago, and not willingly admitting any fundamental alteration since in the racial type.

His volume is divided into several parts, the first embracing a review of what the Greek and Roman writers said about the area he is discussing. He recognizes the Ligurians as a distinct people, representing, probably, what might be called the autochthonous type. On the other hand, he believes that Gauls, Celts and Germans were a single and exotic type, one that at various remote as well as modern dates invaded the soil of France and made much noise in history, without profoundly affecting the primitive inhabitants.

His chapter on the languages is the least satisfactory of the book. He does not present accurately or even fairly the principles or the results of the best school of linguistic ethnology. His treatment of the Aryan question—one all-important in the prehistory of Europe—is quite inadequate, and is chiefly occupied with the opinions of authors now antiquated (Pictet, etc.).

A chapter on the ancient forms of writing and alphabets which have been discovered in France is abundantly illustrated and full of interest. His conclusion is that neither history, language nor etymology can solve the problem of the origin of the French peoples, so he turns toward prehistoric discoveries.

These occupy the latter half of his work. Here the author is thoroughly at home with his subject. He explains in clear and forcible language the doctrine of the development and transformation of organic forms up to the semi-human *Pithecanthropus*, and finally, to man, in in the early Quaternary. This remote ancestor is traced on the soil of France through his oldest 'Neanderthaloid' condition, when all his tools were of rough stone and his skin still hairy, down to a date when he was rudely assaulted by some people of higher culture arriving from the distant East, bringing with them more murderous weapons of polished stones and the far-killing bow and arrow. These were Neolithic tribes, brachycephali, from somewhere between Thibet and Asia Minor. They were followed in later days by another Asian invasion, from a remoter point of the Orient, who introduced bronze and the knowledge of tin.

From the commingling of these various streams on the soil of France, Professor de Mortillet would derive the present French nation, allowing, in addition, the known historic alliances. His principal point is, that from remotest antiquity, unerased by boreal glaciers or Roman swordsmen, by Semitic pirates or Allemanian war-lords, there has lived in the fertile valleys and on the green mountain sides of France the same 'patient, industrious democracy,' which, by its tenacious energy and unflagging labor has placed their nation as the leader in the van of modern civilization.

There is much in these theories of prehistoric migration in conflict with prevailing opinion in France itself—much that the author fails to support by convincing arguments. But apart from all questions of opinion, no reader can be disappointed in the remarkable amount of accurate information gathered in his pages and presented in a bright, pleasing style, which will render the volume attractive even to those who are but incidentally interested in the problems it undertakes to solve.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, JUNE.

The Constituents of Pennsylvania, Ohio and Canadian Petroleum between 150° and 220°: By C. F. MABERY. The author refers to the conflicting statements published with regard to the composition of Pennsylvania petroleum based partly on the results of investigations on the Rus-

sian oil and partly on the results of Warren's and Pelonge's and Cahours' investigations of Pennsylvania petroleum. He shows that Pelonge's and Cahours' distillations were not carried far enough to obtain individual products and that, while Warren's separations were very thorough, his methods of purification were very crude and insufficient. In the work here described two principal objects were kept in view: the one to determine the series of hydrocarbons which form the main body of American petroleum, and the other to ascertain whether the composition of Pennsylvania, Ohio and Canadian oils, as regards their principal constituents, is the same. The author concludes from the results of a very thorough and exhaustive study that the constituents of Pennsylvania petroleum with boiling-points at 163°–164°, 173°–174°, 196°–197°, and at 215°–216°, are decanes and constitute the main body of the petroleum within these limits, and that whatever other bodies may be present are to be found only in small quantities. In order to obtain these products not only was prolonged distillation resorted to, but the products were treated with strong acids and sodium. In the Ohio petroleum the same products were obtained; but the amount of aromatic hydrocarbons is greater here than in the Pennsylvania oil. In the Canadian oil the products were the same as the others up to 173°. Products boiling at 196° and 214° were shown to belong to the series C_nH_{2n} and not, as the lower members do, to the series C_nH_{2n+2}. Although sulphuric acid is used on the large scale in refining oils, no definite information has ever been obtained as to its chemical action in these cases; but the author suggests some possible explanations. The author and Mr. E. J. Hudson have studied the refractive power of these products and find that the refractive power varies, as the specific gravity does, with the purity of the distillate.

On the Molecular Rearrangement of the Oximes by Means of Certain Metallic Salts: By W. T. Comstock. The author has found that not only does phosphorus pentachloride, strong sulphuric acid and several other reagents effect the Beckmann rearrangement of an oxime into an amide, but that several metallic salts are capable of producing the same results. He has found that cuprous chloride and bromide and antimony trichloride effect this reaction with the greatest ease. An intermediate cuprous chloride addition product is obtained in most cases, but this easily breaks down when the benzene solution is heated and forms the amide.

The Action of Urea and Primary Amines on Maleïc Anhydride: By F. L. Dunlap and I. K. Phelps. The authors have continued their experiments on a method described by them for obtaining imides by the action of urea on the anhydrides of dibasic acids. The intermediate addition product, which is an acid, was obtained in some cases, and attempts were made to prepare the imide of maleïc acid by this method. The intermediate product, maleüric acid, was easily obtained, but all attempts to obtain an imide in quantity sufficient for an examination failed. Several products were obtained by the action of primary amines on maleïc anhydride.

On the Isomeric Chlorides of p-Nitro-o-Sulphobenzoic Acid: By Ira Remsen and G. W. Gray. The formation of two chlorides of orthosulphobenzoic acid suggested experiments with substituted acids to see if isomeric chlorides could be obtained from these also. The authors have obtained the two chlorides from the p-nitro substituted acid in well characterized form, and have studied the transformations which take place under the influence of various reagents. Both give the same product with water; but when treated with ammonia the symmetrical compound forms the ammonium salt of the corresponding sulphinide, while the unsymmetrical compound gives the ammonium salt of the corresponding cyansulphonic acid. The structure of the two chlorides is best represented by the following formula:

$$C_6H_3(NO_2)<^{COCl}_{SO_2Cl} \text{ and } C_6H_3(NO_2)<^{CCl_2}_{SO_2}>O.$$

A number of salts of the sulphinide and sulphonic acid were made and studied, as well as the chloride and amide of the acid.

A Study of Ferric Hydroxide in Precipitation: By V. J. Hall. It is well known that many precipitates have the power to carry down other substances with them, and this is generally explained as an act of mechanical inclusion. Results obtained in a study of the action of potas-

sium hydroxide on aluminum sulphate have, however, led to the conclusion that the act is not entirely a mechanical one, but that it is a phenomena of strictly chemical nature. In the present paper the author has undertaken a study of the action in the case of iron hydroxide. While the results are not sufficient to definitely establish the nature of the action, they are inconsistent with the theory of mechanical inclusion and characteristic of chemical action. Reviews of the following books are also contained in this number of the journal:

'The Constants of Nature,' F. W. Clarke, Part V.; 'The Chemistry of Dairying,' N. Snyder; 'Inorganic Chemical Preparations,' F. H. Thorp; 'Traité Elementaire de Chimie,' Haller et Muller; 'The Principles and Practice of Agricultural Analysis,' H. W. Wiley, Vols. I., II. and III.; 'Vorlesungen über Bildung und Spaltung von Doppelsalzen,' J. H. Van't Hoff; 'An Outline of the Theory of Solutions and Its Results,' J. L. R. Morgan.

J. ELLIOTT GILPIN.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 278TH MEETING, SATURDAY, MAY 22.

DR. ERWIN F. SMITH described 'A Bacterial Disease of Cruciferous Plants,' illustrating his remarks by means of drawings, diseased plants, and cultures of the organism on various media. The parasite is a yellow germ and is considered identical with that isolated by Professor L. H. Pammel from rotting turnips. Nearly all of Pammel's statements are confirmed, and much new information has been obtained concerning pathogenesis, symptomatology, host plants, manner of infection, thermal relations of the organism and its behavior in a variety of media. The organism was isolated from Maryland turnips and Wisconsin cabbages and a parallel series of cultures and experiments instituted. The following plants have been artifically infected: Cabbage, kale, cauliflower turnip, rape, black mustard, and radish. The dissemination of the disease is probably due in great measure to insects. It has been transmitted in the greenhouse from diseased to healthy plants by means of slugs (*Agriolimax agrestis*) and also by means of the common cabbage worm (larvæ of *Plusia brassicæ*). The organisms show a marked preference for the vascular system of the plants, and a blackening of the veins of the leaves and of the vascular bundles of the stem is a prominent symptom. The vessels become crowded so full of the germs that they may be said to be plugged solid. The interior of the turnip rots, and the cabbage loses many leaves and fails to produce any head. The disease is widespread and well known to market gardners. The organism is rod-shaped, motile, ærobic; it does not produce gas or acid; it liquefies gelatin; it grows rapidly at room temperature (20° to 26° C.), especially on potato. It grows feebly at blood heat, and will not grow in the thermostat at 40° C. The thermal death point is approximately 51° C. It produces a brown pigment when grown on slices of turnip, but not when cultivated on potato or in beef broth.

Dr. B. T. Galloway spoke on 'the Effects of Environment on Host and Parasite in certain Diseases of Plants.'

It was stated that plants in their growth and development are controlled by two sets of factors, namely, inherited disposition acting from within and external influences acting from without. Around these factors are centered many complicated phenomena, and the object of the paper was to call attention to some of these in their relation to certain physiological and pathological problems. The statements in the main refer to cultivated plants, for in dealing with them in questions, such as those under consideration, conclusions could not be drawn from the behavior of wild species, except in the most general way. In other words, one of the fundamental tenets of agricultural and horticultural practices is that the occurrence and behavior of native plants in any given region is not in itself sufficient evidence to prove that cultivated forms may be successfully grown there. Purely local conditions may make the difference bebetween success and failure in growing the crop, and the effects of these conditions must be determined by observations and experiments on the plant itself.

The effects of environment on the host and the possible changes in the life processes as a

result of changed conditions were pointed out. The effects of the same conditions on the parasite were also considered. Finally attention was called to the cumulative effects of the attacks of parasitic fungi and other organisms. It was shown in certain cases that when plants are attacked by fungi there is a temporary expenditure of vital energy, and as a result metabolic processes are brought about which may put the host in a more receptive condition for further attacks. The following case was cited: "A disease of a greenhouse plant is in a specific case due to the attacks of a fungus which kills the leaf in distinct spots. These spots are frequently so numerous as to entirely destroy the plant. The disease develops naturally under certain rare conditions in the greenhouse. These conditions, however, can be produced artificially in the case of individual plants, and in such instances the spores of the fungus, which are always present in the house, will infect and in a short time produce the characteristic injuries. Now, by following this method for several months and causing the new leaves to become infected as they appear, the plant eventually gets into a condition when it can no longer resist the fungus. If the leaves are all cut off at this time the new leaves will be attacked as fast as they appear, without taking any precautions to surround the plant with conditions that will make it susceptible. The cumulative effects of the fungus, in other words, has probably resulted in bringing about the metabolic changes that at the outset had to be brought on by conditions of light, heat and moisture."

Mr. V. K. Chesnut presented a paper entitled 'The Poison of the Black Nightshade (*Solanum nigrum*. L.),' being a brief account of solanine. This glucoside-like alkaloid, although not a remarkably poisonous substance, is the active constituent of the plant. It is present in the leaf and berry, but in varying amounts according to conditions of growth. It is greatest in heavy-scented plants, but in some the amount is so small that the berry is edible, and has even an attractive taste. Severe cases of poisoning have, however, attended the use of the plant; so it can not be recommended as a food. The variation in chemical composition was attributed to the cosmopolitan nature of the plant which enables it to thrive well in different environments. Attention was called to the fact that the berries of *Solanum triflorum*, a native of the Great Plains region, was poisoning cattle in Nebraska.

F. A. LUCAS,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL Meeting was held April 21st, fifty-nine persons present.

Mr. Herbert Lyon Jones spoke of the biological adaptations of our seashore plants, and defined the physiological differences between them and our ordinary plants. The classes and characteristics of seashore plants were mentioned, the vertical position of the leaves and the reduction of leaf surface noted.

The danger of too great a quantity of salt in the tissues of seashore plants is reduced by changes which reduce transpiration of water; adaptations follow the needs of plants; the fruit is especially adapted to withstand the effects of water. The differences and similarities between the plants of the seashore and desert plants were pointed out and illustrated by a series of lantern slides.

SAMUEL HENSHAW,
Secretary.

NEW BOOKS.

The Chances of Death and other Studies in Evolution. KARL PEARSON. London and New York, Edward Arnold. 1897. Vol. I., pp. xi + 388. Vol. II., pp. 460. $8.00.

Contribution towards a Monograph of the Laboulbeniaceæ. ROLAND THAXTER. Cambridge University Press, John Wilson & Son. Pp. 398. 26 Plates.

Sight. JOSEPH LE CONTE. New York, D. Appleton & Co. 1897. Pp. xvi + 312. $1.50.

An Essay on the Foundations of Geometry. BERTRAM A. W. RUSSELL. Cambridge University Press. 1897. Pp. xvi + 201.

The Induction Coil in Practical Work. LEWIS WRIGHT. London and New York, The Macmillan Co. 1897. Pp. viii + 172.

SCIENCE

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FRIDAY, JUNE 25, 1897.

CONTENTS:

The American Association for the Advancement of Science 965

Internal Secretions Considered from a Chemico-physiological Standpoint: R. H. CHITTENDEN 966

A Case of Primitive Surgery: FRANK HAMILTON CUSHING 977

The Influence of Environment upon the Biological Processes of the Various Members of the Colon Group of Bacilli: an Experimental Study: ADELAIDE WARD PECKHAM 981

The Virginia Colony of Helix Nemoralis: T. D. A. COCKERELL 985

Current Notes on Meteorology:—
Navigation in Fog; Hydrographic Cloud Types; Recent Publications: R. DEC. WARD 986

Current Notes on Anthropology:—
The Antiquity of Bornholm; The Chaco Tribes; The Celts and their Wanderings: D. G. BRINTON 988

Scientific Notes and News 989

University and Educational News 992

Discussion and Correspondence:—
Is the Loess of either Lacrustine or Semi-marine Origin? J. E. TODD. *Monument to the late Buys-Ballot:* A. LAWRENCE ROTCH. *Organic Selection:* C. LLOYD MORGAN 993

Scientific Literature:—
Merrill's Treatise on Rocks, Rock-Weathering and Soils: J. B. WOODWORTH. *Chapman on Bird Life:* HARRY C. OBERHOLSER 995

Scientific Journals:—
The American Journal of Science 998

Societies and Academies:—
The New York Academy of Sciences: J. F. KEMP. *Zoological Club of the University of Chicago* 999

New Books 1000

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE preliminary announcement of the forty-sixth meeting, to be held at Detroit, from the 9th to the 14th of August, has been prepared by the Permanent Secretary. The arrangements have in large measure been already announced in this JOURNAL, and we hope to print later the provisional programs of the Sections. The approaching meeting has aroused much interest in Detroit and throughout the State. Strong local committees have been appointed and excellent arrangements have been made for the meetings and for the entertainment of members.

The first meeting of the Council will be at noon, on Saturday, August 7th, at the Hotel Cadillac, which will be the headquarters of the Association. The offices of the local committee and of the Association, as well as the halls for the general sessions and rooms for all the Sections, will be in the Central High School of the city of Detroit. This new school building is most admirably adapted for the purpose, and has a large number of halls of a suitable size for the meetings of the Sections; while the Auditorium Hall accommodates over two thousand persons.

On the morning of Monday, August 9th, the first general session will be held at 10 a. m. Owing to the death of Professor Edward D. Cope, the President of the Asso-

ciation, Professor Theodore Gill, of Washington, D. C., as Senior Vice-President, will call the meeting to order and introduce the President-elect, Professor Wolcott Gibbs, of Newport, R. I. Addresses of welcome will be made by Mayor William C. Maybury and Hon. Thomas W. Palmer, and President Gibbs will reply. Announcements by the General, Permanent and Local Secretaries will be made and after adjournment the Sections will be organized.

On the afternoon of Monday, August 9th, the Vice-Presidents of the Sections will make addresses as follows:

At half-past two o'clock. Vice-President Barus, before Section of Physics: 'Long Range Temperature and Pressure Variables in Physics.' Vice-President McGee, before Section of Anthropology: 'The Science of Humanity.' Vice-President White, before Section of Geology and Geography: 'The Pittsburg Coal Bed.'

At half-past three o'clock. Vice-President Beman, before Section of Mathematics and Astronomy: 'A Chapter in the History of Mathematics.' Vice-President Colburn, before Section of Social and Economic Science: 'Improvident Civilization.' Vice-President Howard (nominated by Council to fill vacancy caused by the death of Dr. G. Brown Goode) will give by request of the Council an address before Section of Zoology, subject to be announced.

At half-past four o'clock. Vice-President Mason, before Section of Chemistry: 'Sanitary Chemistry.' Vice-President Atkinson, before Section of Botany: 'Experimental Morphology.' Vice-President Galbraith, before Section of Mechanical Science and Engineering: 'Applied Mechanics.'

On Monday evening Dr. Theodore Gill will give a memorial address on the life and work of the late President of the Association, Professor Edward D. Cope.

The meetings of the Sections will follow on the mornings and afternoons of Tuesday, Wednesday, Thursday and Friday. It is expected that on two days of the week the Geological Society of America and the American Chemical Society will hold meetings occupying the time of Sections E and C.

The usual receptions and excursions have been planned, including a visit to Ste Claire Flats, on Saturday after the adjournment. It is expected that the members of the Association at Detroit will go in a body to Toronto to join in welcoming the members of the British Association to America. For this purpose special rates will probably be secured by steamer and train from Detroit to Toronto.

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*INTERNAL SECRETIONS, CONSIDERED FROM A CHEMICO-PHYSIOLOGICAL STANDPOINT**

In considering this subject from a chemico-physiological standpoint allow me at the outset to emphasize the fact, now well established, that the symptoms which follow the simple removal of a physiologically active gland from the body result wholly from the loss of the gland. You may recall that when attention was first drawn to the possibility of producing the typical symptoms of myxœdema in monkeys by removal of the thyroid gland there was a tendency to assume injury to the sympathetic or other nerves of the neck as an explanation of the phenomena, rather than to admit the possibility even of a general or limited disturbance of the metabolism of the body through chemical changes associated with removal of the gland. It was not until the experiments of Murray made clear the fact that the effects resulting from the removal of the thyroid in man could be overcome, in part at least, by administration of the gland-substance that scientific investigation took the proper turn and a full realization of the possible importance of the so-called ductless glands and their internal secretions began to dawn upon the mind. To-day, however, we recognize their functional activity as a necessary element for the welfare of the body. Their removal, or any impairment of their function, may produce even more disturbance of physiological equilibrium than a corresponding disarrangement of glands formerly consid-

*Read at the Fourth Triennial Congress of American Physicians and Surgeons, May 5, 1897.

ered of greater physiological value. Further, it needs to-day little argument to support the view that such power as these physiologically active glands possess is due to definite chemical compounds elaborated by the glands as products of their individual secretory or metabolic activity. As with other glands having more obvious functions, the secreting cells plainly manufacture certain specific products, but in the case of the internal secretions these products find their way into the blood and lymph, by which they are distributed throughout the body, and thus made available either in controlling or regulating the general nutrition of the economy or to serve some more specific purpose of equal importance for the welfare of the organism. This being so, it is equally probable that in the general and specific metabolism going on in all the tissues and organs of the body the various products formed and absorbed by the blood and lymph may contribute somewhat to the welfare of the body prior to their excretion. In its broadest sense, therefore, internal secretion must be looked upon as something common to all active tissues, the ordinary katabolic products of both circulating and morphotic proteids, for example, no doubt exerting some physiological action during their transit from the place of their formation to the organ which serves for their excretion. It is well, perhaps, to give full recognition to this possibility, for physiological equilibrium in the broadest sense is clearly dependent upon the harmonious action of a large number of related parts, and experiment only can determine, and perhaps then imperfectly, how far the products of one gland or tissue are essential for the well-being of the whole. We know, however, that certain organs with the products they elaborate can be dispensed with, while the removal of other organs involving no greater surgical interference is quickly followed by marked disturbances and later by death. Czerny had no difficulty in removing the stomach from dogs, the health of the animals remaining unimpaired when the œsophagus was properly joined to the intestine. Similarly, Schäfer and Moore* have recently shown that both parotids and both submaxilliary glands may be removed from the dog without any disturbance of nitrogenous metabolism, or without any apparent effect upon carbohydrate digestion. Evidently these glands do not possess any intrinsic internal secretion necessary to the life of the animal or having any important action on the metabolic processes of the body. If they do furnish an internal secretion it obviously must be one common in function to that supplied by some other organ. In the present discussion, therefore, we may advantageously limit the term 'internal secretion' simply to those specific products which, being manufactured in certain definite glands, are plainly endowed with well-defined physiological action.

Let us first consider the thyroid gland upon which more work has been done than upon any other similar structure. Dating from 1883, when Kocher and Reverdin published their well-known observations on the effects of thyroidectomy in the human subject, it has gradually become apparent that there are two distinct ways in which the effects of the operation may be manifested.† Thus, in some animals, as in most carnivora, complete removal of the thyroidal tissue is followed by a rapid development of symptoms indicating a marked irritation of the nervous and muscular systems as manifested by tetanus, epileptiform convulsions, etc., terminating in death. In other cases

*Proceed. Physiol. Soc; Journal of Physiol. Vol. 19, No. 4.

† Compare Roos: Ueber die Einwirkung der Schilddrüse auf den Stoffwechsel nebst Vorversuchen über die Art der wirksamen Substanz in derselben. Zeitschr. f. physiol. Chem. Band 21., p. 19. This paper contains numerous references.

slowly developing changes are observed corresponding to myxœdema. Hence, in some animals thyroidectomy is followed by such a marked disturbance of physiological balance that death results very quickly, while in others the development of symptoms is very slow, giving rise to chronic effects which may endure for months. Evidently, aside from the more acute and toxic effects which may immediately follow the operation, there are more gradual disturbances of metabolism which eventually lead to the complete breaking down of the animal. That the symptoms thus produced are dependent upon the withdrawal from the system of certain specific products is evident from the fact that after extirpation of the thyroidal tissue the mere feeding of thyroid glands, or the subcutaneous and intravenous injection of thyroid extracts, suffices to quickly dispel the myxoedemal swellings, the rough thickened condition of the skin, the muscular and mental apathy, etc.* With dogs the convulsions which follow extirpation of the thyroids are quickly checked by the subcutaneous injection of thyroid extracts. Experiments along these lines with extracts of dead tissue have, as you know, made it very evident that the thyroid gland forms some one or more specific substances, the absence of which from the body sooner or later renders life impossible. Where, however, the animal, as a dog, is provided with accessory thyroids the entire thyroid gland may be removed without death resulting, providing one of the parathyroids is left, but if both parathyroids are excised then 40 per cent. of the thyroidal tissue proper must be left in order to have the dog live.† Evidently, the thyroids and accessory thyroids have more or less of a common function, the one being able to fulfil the purpose of the other to a certain degree; a fact which in itself may be taken as evidence of the importance of thyroidal tissue and the care exercised by nature in preventing its complete suppression.

The very nature of the physiological results which follow the removal or accompany the atrophy of the thyroidal tissue suggests the formation of one or more toxic substances to which the well marked symptoms are due; substances which are either not formed in the presence of thyroidal tissue or else being formed are either neutralized (physiologically) or decomposed and rendered inert by substances furnished by the thyroid gland. Such a view obviously implies a difference in the character and possibly in the extent of the metabolic changes going on in the body, and we may, therefore, advantageously consider the character of our knowledge upon this subject. A careful study of the literature shows quite clearly that certain definite statements are justified. Thus, Leichtenstern and Wendelstadt* found by feeding thyroid glands to healthy obese individuals that a marked loss of body-weight resulted. Roos,† experimenting with normal dogs, observed that in feeding the gland substance for several days there was a marked increase in the excretion of nitrogen through the urine, also of sodium chloride and of phosphoric acid (P_2O_5). On dogs with the thyroids removed, this action was still more marked, so far as the excretion of nitrogen and chlorine was concerned, also in the loss of body-weight and in the excretion of water, but the excretion of phosphorus fell behind the normal. Further, in an ex-

* See Kent: Thyroid extract after Thyroidectomy. Proceed. Physiol. Soc; Journal of Physiol. Vol. 15. Also Meltzer: Ueber Myxödem. Centralbl. f. Physiol. 1894, p. 698.

† Edmunds: Observations on the Thyroid and Parathyroid of the Dog. Journal of Physiol. Vol. 22. Proceed. Physiol. Soc. June 27, 1896.

* Ueber Myxœdem und Entfettungskuren mit Schilddrüsenfütterung. Deutsch. med. Wochenschr. 1894. No. 50.

† Loc. cit.

periment with a goitre-patient, otherwise healthy, Roos observed on feeding thyroid glands a similar tendency towards increased excretion of nitrogen and chlorine with a marked increase in the output of phosphoric acid. Mendel, Napier, Ord and others, making observations on myxoedema patients, likewise noted that the use of thyroid preparations by subcutaneous injection, by glycerin extracts, etc., as a rule, not only led to a betterment of the symptoms, but gave rise to a marked diuresis, loss of body-weight and increased excretion of nitrogen or urea. Denning,* likewise, found that while different individuals reacted somewhat differently under thyroid feeding, yet there was a general tendency toward increased excretion of nitrogen as well as a loss of body-weight. It was also noted that the excretion of nitrogen and urea was not always parallel. Occasionally albumin and sugar appeared in the urine. In one case the volume of urine excreted rose at once 200 cc. per day, the pulse rate increased 22 per cent., while the nitrogen excreted rose 15 per. cent during the feeding period. Similarly, in Basedow's disease, Scholz† observed under the influence of thyroid feeding in a patient 29 years old diuresis, increased excretion of nitrogen and sodium chloride with a marked decrease in the excretion of phosphoric acid. Magnus Levy‡ likewise records that a healthy individual taking thyroid tablets for 19 days lost 7 pounds body-weight with some increase in O_2 and Co_2 exchange. In three cases of Basedow's disease, on the other hand, oxygen consumed and carbonic acid excreted were greatly in excess of the normal. Fritz Voit,* by carefully conducted experiments on healthy dogs, found that the feeding of fresh thyroid glands produced a marked increase in the output of carbonic acid as well as of nitrogen. Michaelson† found after extirpation of the thyroid in hungry cats the Co_2 excretion increased, while J. L. Smith‡ has observed that when thyroidectomy is performed on cats there is a marked disturbance of the heat-regulating mechanism.

From these and other observations that cannot be recorded here it is very plain that the administration of thyroid gland and thyroid extracts to normal individuals, and especially to thyroidectomized animals and individuals in whom the thyroid glands are diseased, produces a very noticeable effect upon the metabolism of the body, leading to a marked loss of body-weight, an increased excretion of water, nitrogen and carbonic acid, and also of sodium chloride. This great diminution of body-weight is by no means due wholly to loss of water nor to removal of fat, for if a healthy individual is fed upon a diet rich in fats and carbohydrates the well-known proteid-sparing power of the latter foods is not able to keep down the loss of nitrogen when thyroids are administered. Proteid material is still broken down in increased quantity, and not from any individuality of the person experimented upon, but plainly under the ex-

* Ueber das Verhalten des Stoffwechsels bei der Schilddrüsentherapie. Münchener med. Wochenschr. 1895. No. 17. Also No. 20.

† Ueber den Einfluss der Schilddrüsenbehandlung auf den Stoffwechsel des Menschen insbesondere bei Morbus Basedowii. Centralbl f. innere Med. Band 16, p. 1041 and p. 1069.

‡ Ueber den respiratorischen Gaswechsel unter dem Einfluss der Thyreoidea, sowie unter verschiedenen pathologischen Zuständen. Berliner klin. Wochenschr. 1895, p. 650. See also Richter: Zur Frage des Eiweisszerfalles nach Schilddrüsenfütterung. Centralbl. f. Physiol. Band 10, p. 49. Also Ducceschi: Beitrag zur Erforschung der Stoffwechselvorgänge bei thyroidectomirten Thieren. Ibid. Band 10, p. 217.

*Stoffwechseluntersuchungen am Hund mit frischer Schilddrüse und Jodothyrin. Zeitschr. f. Biol. Band 35, p. 116.

† Jahresbericht f. Thierchemie. Band 19, p. 335.

‡ On some effects of Thyroidectomy in animals. Journal of Physiol. vol. 16, p. 378.

citing influence of the thyroid.* The gland substance evidently causes an increased decomposition of the tissue proteids, thus showing a certain resemblance to the action of phosphorus on the organism (Roos). At the same time the loss of body-weight under thyroid feeding is far greater than can be accounted for by the increased proteid decomposition, from which, in conjunction with the increased gaseous exchange, we must infer an increased breaking down of fatty tissue in accord with the prevalent idea that thyroids tend to reduce obesity. This, furthermore, is in harmony with the well-known fact that increase in proteid metabolism is almost invariably associated with increase in the metabolism of non-nitrogenous matter.

The significance to be attached to this increase in proteid metabolism, however, is, I think, something more than a mere quantitative one. The very fact that there are quantitative changes renders it quite probable that there are also qualitative changes, and that the presence or absence of the thyroid gland or its equivalent from the body may modify the *line* of metabolism. Upon this point, however, we know very little; we simply infer. Still there are some facts in connection with the proteids of the blood which are worthy of a moment's consideration. Thus, it has been shown by comparison of the proteids of normal dog's blood with those present in the blood after extirpation of the thyroids that in the period preceding the convulsions the percentage amount of serum-albumin is increased and the globulins decreased. In the second period, on the other hand, when the cramps or convulsions appear up to the end, there is a progressive increase in the amount of globulin and a decrease of serum-albumin as well as of the total proteid. Hence, there is at first an increase and then a decrease of the albumin quotient. From this it would appear that in the first stages there is an abatement of the metabolism of the tissues, followed by an increase, and that possibly in the incomplete breaking-down of the proteid material intermediate toxic products appear which are the cause of the cachexia.* Further, according to Formánek and Haskovec,† in the thyreopriva cachexia, resulting from the extirpation of the thyroids in dogs, the number of red blood corpuscles is systematically diminished, while the leucocytes are increased, and the dry residue of the blood as well as the iron and hæmoglobin are diminished. In connection with the diminution of hæmoglobin there is an acceleration of respiration and of the pulse, which, however, in the terminal stages of the cachexia diminishes. The iron liberated by the decomposition of the red blood corpuscles is deposited in the organs of the body, especially in the spleen and lymph glands. If the blood is taken for examination during a convulsive seizure, on the other hand, it shows a reversal of the above conditions; it is thicker, contains more solid matter, as well as iron and hæmoglobin. If extract of the thyroid is injected into the operated animal there is an immediate increase in the number of red corpuscles and a betterment of the animal's condition. Hence, the thyroid is evidently concerned in hæmatosis, and it is quite possible that the decomposition of the blood which takes place induces certain alterations in the formation of the end-products of metabolism, so that poisons result which give rise to intoxication of the organism. Just here it may be

* Bleibtreu und Wendelstadt. Stoffwechselversuch bei Schilddrüsenfütterung. Deutsche med. Wochenschr. 1895, p. 348.

* Beitrag zur Lehre über die Function der Schilddrüse, Jahresbericht f. Thierchemie, 1895, p. 375.

† Ducceschi: Ueber die Bluteiweissstoffe des Hundes im Verhältniss mit den Folgen der Schilddrüsenexstirpation. Centralbl. f. Physiol. Band 9, p. 359.

mentioned that some recent observations on the feeding of thyroids in insanity tend to show that the percentage of the small mononuclear cells or lymphocytes of the blood are increased while the multinuclear neutrophiles are correspondingly diminished under the action of the drug, thus suggesting that the gland-tissue or its active principle has a direct stimulating influence upon those tissues of the body directly concerned in the production of the lymphocytes, viz, the lymphatic or adenoid tissues.*

In addition to these changes, emphasis must be laid upon the apparent connection between the thyroid gland and phosphoric acid metabolism. Thus, the increased excretion of P_2O_5 after feeding thyroids to normal animals, and the great decrease in the case of animals with the thyroids removed, is naturally suggestive. The facts may be explained in two ways: either the metabolism of phosphoric acid and its excretion are retarded in the absence of the gland, so that there is a retention of P_2O_5 in the body, or else the organism can assimilate sufficient phosphoric acid only in the presence of the substance or substances furnished by the thyroid gland (Roos). It has been suggested, as you know, that the activity of the thyroid gland is a toxic one, but that this action is normally paralyzed by some one or more products of its own metabolism. The view that in the absence of the thyroid gland not enough P_2O_5 can be assimilated for the wants of the body finds a certain degree of confirmation in some of the symptoms noticeable in cretinism and myxoedema; viz, the retardation in bone-development and the slow calcification in cretinism. On the other hand, the tendency toward tetanus might perhaps be explained on the ground of an acute P_2O_5 retention in the central nervous system similar to that of uræmia; or, equally plausible, as due to a marked deficiency of P_2O_5 in this tissue. Thus, in Basedow's disease the observations of Kocher that administration of sodium phosphate leads to a marked betterment of all the symptoms are directly pertinent.

Further, we must not overlook the fact clearly shown by Halliburton,* in connection with Horsley, that after thyroidectomy there is a distinct tendency toward an increase in the percentage of mucus in the tissues of the body, especially marked in the connective tissues and salivary glands. While this increase is not as great as at one time thought, it is still distinctly recognizable and affords additional evidence that the thyroid plays some important part in the katabolic processes of the body, and that when it is removed or diseased the normal chain or rhythm of metabolism is broken. As to the chemical nature of the products which are directly responsible for the results attending thyroidectomy or associated with a morbid condition of the thyroid we have no direct knowledge, and as to their physiological character we can only infer from the nature of the symptoms which result. It is to be presumed that the toxic products are formed not in the thyroid, but in the tissues of the body and as a result of perverted metabolism due to atrophy or alterations of the thyroid gland. The latter evidently furnishes something which either directly neutralizes toxic products common to the body, or far more probably prevents their formation through an influence upon the line of metabolism, or to give due weight to all the views which have been advanced, both suggestions may be correct.

What now is the chemical and physiological character of the protective products which thyroidal tissue evidently manufactures? To this question there are many conflicting answers; still out of the chaotic mass of material available I think it is pos-

* Perry: Some studies of the blood in Thyroid feeding in Insanity. *Medical Record*, August, 1896.

*See Halliburton's Handbook of Chemical Physiol., p. 505.

sible to draw certain definite conclusions. In the first place it must be remembered that the epithelial cells of the thyroid gland apparently manufacture a so-called colloid secretion which evidently finds its way into the blood through the lymph, presumably carrying with it the active principles. This secretion obviously cannot be collected for study, but such active principles as it contains may be sought for in the gland itself, since we have every reason to believe in their ready solubility. By histological methods applied to sections of the thyroid it has been shown that the colloid matter gives the general proteid reactions, that it is very soluble in dilute alkaline fluids and readily dissolved by gastric digestion.* Our knowledge of the chemical composition of the thyroid gland, and hence presumably of the colloid secretion, is due mainly to the work of Bubnow,† Gourlay,‡ Notkin,§ Moscatelli,|| Fränkel,¶ and especially Baumann and Roos,** and Hutchinson.†† To briefly summarize the present state of our knowledge, ignoring minor points of difference, I think it is quite clear that the thyroid gland is especially characterized by the presence of a compound proteid of peculiar constitution, and that this substance which Hutchinson calls 'colloid matter' is the active constituent of the gland. There is also present another proteid, a nucleo-albumin, in small amount, which Hutchinson considers as probably contained in the cells of the acini. In addition there are certain extractives to be found, viz., xanthin, hypoxanthin, inosite,* volatile fatty acids, paralactic acid, succinic acid and calcium oxalate; bodies, however, of no special physiological significance.

The chief interest centers around the above mentioned proteid material, which is plainly of a peculiar kind, since it tends to hold a certain amount of iodine in combination and yields on decomposition a peculiar non-proteid substance carrying with it most, if not all, of the iodine and endowed with marked physiological action. This latter substance, to which Baumann has given the name of thyroiodin, later changed to iodothyrin, is especially characterized, chemically, by its great resistance to ordinary decomposing agents. Digestion of the thyroid gland with active gastric juice yields the iodothyrin as an insoluble residue, but still active. The gland can even be boiled an entire day with ten per cent. sulphuric acid without loss of the active principle, the latter separating from the cooled fluid as a fine flocculent precipitate almost wholly insoluble in cold water and acid, soluble in hot alcohol and readily soluble in dilute alkalies. When purified by repeated precipitation, re-solution, etc., the body may contain as much as ten per cent. of iodine. In the gland, according to Baumann, iodothyrin exists in great part combined with albumin and in smaller amount with globulin, and these compounds are likewise physiologically active,

*Langendorff; Beitrag zur Kenntniss der Schilddrüse. Du Bois-Reymonds Archiv f. Physiol., 1889, Supplementheft, p. 219.

†Beitrag zur d. Untersuchung der chemischen Bestandtheile der Schilddrüse des Menschen und des Rindes. Zeitschr. f. Physiol. Chem., Band 8, p. I.

‡The Proteids of the Thyroid and the Spleen. Journal of Physiol., Vol. 16, p. 23.

§Zur Schilddrüsen-Physiologie. Virchows Archiv. Band 114. Supplementheft, p. 221.

||Beiträge zur Kenntniss der Milchsäure in der Thymus und Thyreoidea. Zeitschr. f. physiol. chem. Band 12, p. 416.

¶Thyreoantitoxin, der physiologisch wirksame Bestandtheile der Thyreoidea. Wiener klin. Wochenschr., 1895, No. 48.

**Ueber das normale Vorkommen des Jods im Thierkörper. Zeitschr. f. physiol. Chem. Band 21, p. 319 and 481. Band 22, p. 1.

††The Chemistry of the Thyroid Gland and the nature of its active constituent. Journal of Physiol. Vol. 20. p. 474.

*Tambach. Pharmaceutische Centralhalle, March, 1896.

although less so than the iodothyrin itself. The iodothyrin of Baumann is thus a non-proteid cleavage product of a more complex body, naturally present in the gland and characterized by containing both iodine and phosphorus (0.5 per cent.). Aqueous and glycerin extracts of the gland contain iodothyrin or the mother-substance, although they do not take up all of the substance. Extraction of the gland with 0.75 per cent. sodium chloride solution, frequently repeated, removes all of the iodine-containing substance, and the residual tissue has little or no effect upon goitre.*

That iodothyrin possesses all the peculiarities associated with thyroid-therapy is, I think, pretty thoroughly established. The experiments of Roos† upon animals, and the clinical observations of Leichtenstern and Ewald, have clearly demonstrated the physiological power of the substance. Its action on goitre,‡ as tested in over a hundred cases, is very noticeable. In the parenchymatous form a few day's treatment suffices to greatly reduce the size of the swelling. Normal dogs in nitrogenous equilibrium, treated with iodothyrin, suffer a marked loss of body-weight, an increased excretion of nitrogen, NaCl and P_2O_5, while diuresis is equally marked (Roos). Further, comparative experiments by Fritz Voit,§ most carefully conducted on dogs in nitrogenous equilibrium, with fresh thyroid and iodothyrin show that the latter has practically the same action as the former in increasing the decomposition of fat and in stimulating the metabolism of proteid matter. In myxœdema the physiological action of iodothyrin is equally pronounced. Thus, in one case,* a 16-year-old patient received for 6 days 2 grams of iodothyrin (= 0.6 milligram iodine) daily. In the fore-period of 3 days she received 18.02 grams of nitrogen and excreted 17.88 grams. In the iodothyrin period she ingested 16.2 grams of nitrogen and excreted 20.0 grams, while in the 3 days after-period she consumed 15.65 grams of nitrogen and ingested 21.59 grams. In 10 days the body-weight fell 4 pounds. In the treatment of obesity iodothyrin has likewise been effective.† It has also been clearly established by experiments on dogs that iodothyrin will cut short the various symptoms produced by thyroidectomy, noticeably the convulsions.‡ As Baumann and Goldmann§ have shown, dogs with thyroids removed do not manifest symptoms of tetanic convulsions so long as iodothyrin is given regularly each day in doses ranging from 2 to 6 grams. Further, in such cases the withdrawal of the iodothyrin, or a marked reduction in the amount administered, is generally followed by an appearance of the convulsions. The dosage required to remove or overcome the tetanus of a dog suffering from thyroidectomy is greater the more vigorous the symptoms and the longer the administration has been delayed after the appearance of symptoms.

* Roos: Zur Frage nach der Anzahl der Wirksamen Substanzen in der Schilddrüse. Münchener med. Wochenschr., 1896, p. 1157.

† Ueber die Wirkung des Thyrojodins. Zeitschr. f. physiol. Chem. Band 22, p. 18.

‡ See Ewald und Bruns: Verhandlungen des Congresses für innere Medicin, 1896, p. 101.

§ Stoffwechseluntersuchungen am Hund mit frischer Schilddrüse und Jodothyrin. Zeitschr. f. Biol. Band 35, p. 116.

* Treupel: Stoffwechseluntersuchung bei einem mit Jodothyrin (Thyrojodin) behandelten Falle von Myxoedem und Mittheilung einiger Thierversuche mit Jodothyrin (Thyrojodin). Münchener med. Wochenschr., XLIII. 38, p. 885. See also Notkin, Virchows Archiv. Band 144, Supplementheft.

† See Grawitz: Beitrag zur Wirkung des Thyrojodin auf den Stoffwechsel bei Fettsucht. Münchener med. Wochenschr., 1896, No. 14. Also Henning Ibid., 1896, No 19.

‡ Hoffmeister: Deutsch. med. Wochenschr., 1896, No. 22. Hildebrandt; Berliner Klin. Wochenschr. 1896, No. 37.

§ Ist das Jodothyrin (Thyrojodin) der lebenswichtige Bestandtheil der Schilddrüse? Münchener med. Wochenschr., 1896, p. 1153.

The negative results obtained by Gottlieb* have been recently shown to be due to the employment of a poor preparation.

Does the physiological action of the thyroid gland reside wholly in this so-called iodothyrin or its antecedent? In attempting to answer this question we must give a moment's attention to Fränkel's so-called thyreoantitoxin.† This, as you may remember, is a crystalline body of neutral reaction obtained from the proteid-free extracts of the thyroid gland. It is soluble in water and alcohol, but precipitable by ether and acetone, and from its composition it has been suggested that it is a guanidin derivative. Fränkel ascribed to this substance the physiological activity of the thyroid gland, since he obtained a suspension of convulsions with thyroidectomized cats on injecting this body. Further, Drechsel‡ has made a preliminary communication to the effect that the proteid-free extract of the thyroid from pigs contains two crystalline substances in small amount, which when fed to thyroidectomized animals appear somewhat active, although not strongly so. Drechsel therefore suggests that possibly there may be three active substances present in the thyroid, viz, two bases, one identical with Fränkel's antitoxin, and Baumann's iodothyrin. He would thus ascribe to the thyroid several associated functions and corresponding to each a distinct chemical substance. Theoretically, of course, this is quite plausible, but Drechsel's compounds have not been further heard from and there are many recent observers who fail to find any physiological action whatever with the proteid-free extract from the gland.§ Moreover, careful comparative study of the action of thyreoantitoxin and iodothyrin in a myxoedema patient showed that while the former was entirely without beneficial action the latter produced all the results characteristic of thyroid feeding.* Further, Roos,† by experiment on a normal dog in nitrogenous equilibrium, found that thyreoantitoxin was wholly without influence on metabolism, while iodothyrin given to the same animal under like conditions caused at once a marked increase in the output of nitrogen, NaCl and P_2O_5. In other words, thyreoantitoxin shows with certainty none of the properties of the thyroid gland, while iodothyrin is apparently the physiological equivalent of the gland. Indeed, in its action on goitre iodothyrin is more effective than the gland itself, since when the gland is taken it must first undergo digestion to liberate the iodothyrin and some may be lost by putrefactive changes in the intestine.

What now is the significance of the iodine contained in the so-called iodothyrin? Iodine is not a common constituent of the animal body, and its discovery by Baumann in the thyroid gland toward the end of 1895 was the first intimation of its presence in the human organism. So far as known, it is not normally present to any extent in other tissues.‡ Traces, however, are found in the thymus of the calf (Baumann).§ Barrell has likewise reported the presence of traces in the spleen, adrenals and the ovaries of pigs and cows. The amount, however, is very small as compared with that found in the thyroid. Calling the amount of iodine in 1 gram of fresh thyroid as 1, the spleen contains $\frac{1}{20}$, the adrenals $\frac{1}{130}$, and the ovaries

* Deutsch. med. Wochenschr., 1896, No. 15.

† Wiener klin. Wochenschr., 1895, No. 48.

‡ Die Wirksame Substanz der Schilddrüse, Vorläufige Notiz. Centralbl f. Physiol. Band 9, p. 705.

§ See Hutchinson: The chemistry of the Thyroid Gland and the nature of its active constituent. Journal of Physiol., Vol. 20, p. 491.

* Magnus Levy: Deutsche med. Wochenschr., 1896, No. 31.

† Münchener med. Wochenschr. 1896. No. 47.

‡ Drechsel has reported finding a distinct trace of iodine in the hair of a syphilitic patient treated for a long time with postasium iodide. Centralbl. f. Physiol. Band 9, p. 704.

§ Vorkommen von Jod in den Ovarien. Chemisches Centralblatt, 1897. Band 1, p. 608.

$\frac{1}{63}$—$\frac{1}{65}$ per gram of fresh tissue. Iodine has likewise been detected in the human hypophesis.*

In human thyroids, on the other hand, as well as in the thyroids of sheep, oxen and pigs, iodine is most generally present in quite appreciable amount, and pure iodothyrin may contain as much as 10 per cent. of the element. In iodothyrin the iodine is in close combination with the rest of the molecule and is not easily split off even by the action of alkalies. It is noticeable that the thyroids of sheep (and of other animals) vary greatly in their content of iodine. Thus in sheep coming from Freiburg 1 gram of dry thyroid gland contained on an average 0.9–1.3 milligrams of iodine, while the thyroids from Paris sheep contained 1.15–1.2 milligrams of iodine per gram of dry gland, and those from Elberfeld 1.5–5. milligrams per gram of dry tissue. As judged by the rate and intensity of physiological action 0.25–0.3 milligram of iodine in the form of iodothyrin is equal to 1 gram of fresh thyroid gland. Further, according to Baumann, doses of 1 milligram of iodothyrin which contain only $\frac{1}{10}$ milligam of iodine will produce a decided effect upon goitre after 3–4 applications, thus clearly indicating that it is not the iodine *per se* that is effective, but rather the iodine compound.

The content of iodine in human thyroids is likewise variable, the determining factor being apparently the locality in which the individual lived. Thus, in 26 adults dying from various causes in Freiburg the average amount of iodine in the thyroid was 0.33 milligram per gram of dry tissue, while in Hamburg the average from 30 adults was 0.83 milligram per gram of dry tissue. In Berlin, average of 11 adults, 1 gram of dry thyroid contained 0.9 milligram of iodine. It should be noted, however, that in the Freiburg cases the average weight of the gland was 8.2 grams with a total content of 2.5 milligrams of iodine. In Berlin, on the other hand, the average weight of the dry gland was 7.4 grams with a total content of 6.6 milligrams of iodine per gland, and in Hamburg the dried gland weighed only 4.6 grams, with 3.83 milligrams of iodine.

Recently Weiss* has reported the results from fifty analyses of thyroids of adults and children in Silesia, the average weight of the dried gland being 7.2 grams and with an average content of 4.04 milligrams of iodine.

From a large number of observations among children and adults in different localities in Germany, Baumann concludes that in Freiburg, where goitre is endemic, the weight of the thyroid is the largest and its content of iodine the lowest, while in Hamburg and Berlin, where goitre is not endemic, the reverse holds good. As a rule, in cases of goitre only minimal and almost always relatively small amounts of iodine are to be found, from which Baumann draws the conclusion that between the iodine-content of the thyroid and the occurrence of goitre there is a certain definite relationship.

I understand, however, that additional results, not yet published, tend to show that in some cases of goitre the content of iodine is far beyond the normal, thus implying the existence of two abnormal conditions: one in which the iodine-content is below, and another in which it is far above the normal. In old age the content of iodine frequently falls to a minimum, apparently in harmony with the degeneration of the gland. The largest amount of iodine is found between the ages of twenty-five

*Schnitzler und K. Ewald; Ueber das Vorkommen des Thyrojodins im menschlichen Körper. Wiener klin. Wochenschr., 1896, p. 657.

*Ueber den Jodgehalt von Schilddrüsen in Schlesien Chemisches Central-Blatt, 1897. Band 1, p. 298.

and fifty-five.* Many circumstances, however, combine to modify the content of iodine in the thyroids, especially the proximity to the sea-shore with the greater abundance of sea food, etc., and this fact, coupled with the well-known circumstance that in the thyroids of some children iodine is wholly wanting (Baumann), and this without any apparent effect upon the activity of the gland, renders one somewhat skeptical as to the real virtue of the iodine. Blum,† however, states that artificial compounds of iodine, with various forms of proteid matter, exert a beneficial influence upon parenchymatous goitre as well as upon the tetanus and myxoedema induced in dogs by thyroidectomy. The iodine in iodothyrin is certainly not active as iodine; the amount is too small, and it may, perhaps, be questioned if the amount of iodine in the thyroid gland can be taken as a measure of the amount of active substance present. In this connection it may be mentioned that animals with the thyroids removed have no power of retaining the iodothyrin administered by mouth or subcutaneously, the iodine compound appearing in the urine either unaltered or in some modified form (organic).‡

To summarize, the thyroid gland manufactures *one* specific substance of marked physiological power—the so-called colloid of Hutchinson—a body which, though containing phosphorus, is not a nucleo-proteid; neither is it allied to mucin. It is peculiar in that it contains iodine. This body when acted upon by gastric juice or by boiling acids is split into a proteid and a non-proteid part, the latter containing all of the phosphorus and the larger proportion of the iodine of the original colloid. According to Hutchinson both parts of the colloid are physiologically active, but the non-proteid part, the iodothyrin of Baumann, is unquestionably far more active than the proteid part of the original molecule. This substance is apparently the physiological equivalent of the thyroid gland. Lastly, our history would be incomplete without some reference to the theories of Notkin.* This reference, however, may be a brief one, since the theories though ingenious are now known to rest upon a false foundation and have no present value.

Concerning the other internal secretions of the body I have little to say, partly owing to lack of time and partly because there is very little definite chemico-physiological knowledge at our disposal. Our knowledge has not as yet advanced sufficiently to admit of making dogmatic statements regarding the exact chemical nature of the active principles present in the adrenals, testacles, ovaries, pancreas, pituitary body, etc., or of the exact action of extracts of these glands upon the metabolic phenomena of the body. Allow me to say, however, in reference to the adrenals that there is some evidence of the existence of two distinct physiologically active substances, one insoluble in 90 per cent. alcohol, possibly the sphygmogenin of Fränkel, which increases blood-pressure while the other, which is readily soluble in alcohol, causes paralysis of the heart and muscles and death by suffocation.† In this connection it will be

*See Baumann: Ueber das Thyrojodin. Münchener med. Wochenschr., 1896, No. 14.

† Ueber Halogeneiweissderivate und ihr physiologisches Verhalten. Münchener med. Wochenschr., 49, 1099.

‡ Baumann und Goldmann, Loc. cit. See also H. und M. Frenkel. Jod im Harn nach Einnahme von Thyreodintabletten. Berliner klin. Wochenschr., xxxiii, 37, p. 827.

* Zur Schilddrüsen-Physiologie. Virchows Archiv, Band 144. Supplementheft, p. 224. This paper contains a very full bibliography. Notkin's theories are well combated by Hutchinson, Journal of Physiol., Vol. 20, p. 490.

† See S. Fränkel: Beiträge zur Physiologie und physiologischen Chemie der Nebenniere. Centralbl. f. Physiol. Band 10, p. 486. Du Bois: Note prélimi-

remembered that Oliver and Schäfer* have shown that the active principle (or principles) is non-volatile and that its activity is not destroyed by mineral acids or gastric digestion, while alkalies gradually diminish it. According to Marino-Zuco,† the toxic action is due to the presence of neurin glycerophosphate. There are also some grounds for believing a brenzcatechin-like body to be present,‡ which may exert some physiological action. Lastly, in extracts of the testis a peculiar nitrogenous body has been detected, free from oxygen, known as spermin and which is claimed by Poehl§ to have a marked influence upon metabolism and to act as a true physiological stimulus. Further discussion of these points at the present time, however, would have little value.

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naire sur l'action des extraits de capsules surrénales. C. R. Soc. de Biol., 1896, p. 14.

* The physiological effects of extracts of the suprarenal capsules. Journal of Physiol., Vol. 18, p. 370. See also B. Moore: On the Chemical Nature of the physiologically active substance occurring in the suprarenal gland. Ibid., Vol. 17. Proc. Physiol. Soc., March, 1895.

† Archiv. d. Biol. Ital., Tome 10, p. 325.

‡ Brunner: Chem. Centralblatt., 1892, I., p. 758. Mühlmann: Deutsche Med. Wochenschr., 1896, No. 26.

§ Compt. rendu. Tome 115, p. 129. Zeitschr. f. Klin. Med. Band 26, p. 133. Centralbl. f. d. Med. Wissensch., 1892, p. 950. See also Bubis: Sperminum Poehl in chemischer, physiologischer und therapeutischer Beziehung. Ibid., 1894, p. 703.

A CASE OF PRIMITIVE SURGERY.

DURING the first period of my residence among Zuñi Indians, in the autumn of 1890, I was called in to assist two medicine men or priests in the performance of a peculiarly interesting surgical operation.

A man belonging to the clan into which I had been adopted had for several months been suffering from the effects of either a contusion or a strain of the right foot, caused by a throw from his horse. This had at first given little trouble, then had appeared as an ordinary stone-bruise on the right side of the foot just below the instep. The inflammation had, however, extended until the whole foot and the lower part of the leg had become excessively swollen, so much so as to cause the skin to glisten from stretching, save at a point over and around the original injury, at which point a malignant and putrid sore had developed, the odor of which was extremely offensive, and both the foot and the leg were now of livid, purplish-red hue in places, suggestive of actual decay. As a layman in medicine I should have said that the case was now one of advanced mortification, and from the general condition of the patient I should have inferred that blood poisoning was likely soon to ensue.

I gathered from the conversation of the two old surgeons who had been called in, and who had in return requested my attendance in order that I might give 'ease medicine' and 'add with (my) breath strength and endurance to (my) clan-brother,' that it was these appearances, this apparently '*decaying* condition' of the man's extremity, that had determined them to perform the operation.

When I entered the room the patient was lying on the floor and, although in extreme agony, turned his face toward me expectantly and with a smile, uttering the customary words of welcome. His head was pillowed in the lap of his little old white-haired mother, who was gently stroking his forehead and talking to him in the endearing phrases of mothers to little children. At his side was a small bowl containing a clear but bright red liquid (made, I afterwards learned, from an infusion of willow-root bark) in which half floated, half stood, a cane sucking-tube about six inches long. The old surgeons were removing certain

bandages from the foot and washing off a yellow powder made from pollen and a certain bitter root, with which the sore had been dressed. They bade me sit at the right side of the man, so as to lay my hands on his left breast and to occasionally breathe into his face and administer to him my 'white medicine' (which contained an opiate).

Then they produced, from a buckskin pouch and a roll of rags, a much shattered bottom of a dark-colored glass bottle and two or three broken nodules of obsidian, also several neat splints of cedar and masses of freshly gathered, clean yellow piñon gum, as well as a carefully tied bundle of willow-root bark and some of the yellow roots and pollen I have before mentioned. With a blunt-pointed knife, used vertically, one of them detached, by tapping, a number of small, thin, sharp flakes or chips from the bottle-glass and obsidian. Six or eight of these diminutive flakes were now selected and mounted, each in the cleft end of one of the cedar splints; some so as to form straight lancets, but others at right angles to the splint handles. The blades of one or two of these latter were wrapped round and round with sinew near the point of insertion in the splint, so that only a limited portion of the edge or tip of each protruded. These and the other improvised surgical instruments were laid out in due order on the floor. A quantity of shredded cedar-bark, buckskin scrapings, and old, soft rags were provided; also a large bowl of fresh water, and another filled with the red liquid and containing a small gourd dipper.

Everything being in readiness, the two priests closed their hands over their mouths and breathed into them, as does a man on a cold day, uttering, meanwhile, short invocations, for strength of wind or breath for the patient, and for power of wind or breath of guidance for themselves; literally the supplication was: "Their [The Being's] wind of life, by its power may his will be strengthened and he quieted be, and likewise by it may our methods and good fortune straight be made!" Bidding the man 'Stay himself with endurance,' since 'Things must be as they must, poor child,' and telling me also to 'Stay him,' with my 'Breath of relationship and sympathy,' they set to work without further delay.

First, they bathed his foot to clear it of the astringent yellow powder, and to cleanse the sore in order that they might be the better able to inspect it. Then, very deliberately, they diagnosed the case, frequently comparing notes. It was from this diagnosis that I learned their reasons for attempting the operation. They believed that the flesh of certain muscles in the foot had died or were dying from the violence done them, and were therefore 'wi-wi-yo-a' (worm-becoming, worm-turning) in the depths of the foot. According to this theory, their plan was to make a double, or inverted T-shape, incision so that the integument could be lifted up from the affected parts in two flaps, the 'dead flesh' removed, the 'decayed' or 'black blood' fully extracted, the worms and the 'seed of their kind' found and utterly uprooted. They thereupon mapped out with their fingers the lines of the incisions they proposed to make. One of them gently bade their patient anew to 'Stay himself,' while the other seized his foot with both hands and turned it up, stretching the skin by pressure; then the first grasped one of the obsidian lancets (mounted sidewise and wrapped with sinew so that the point protruded just sufficiently to sever the skin) and deliberately, but with deft and even stroke, slashed down from the ankle about two and a-half inches, along a line corresponding in direction with that of the tendon of the little toe. He then quickly made another slash from the instep straight down to the middle of the first cut. Catching up one of the

other kind of lancets, he deepened both incisions, avoiding with the utmost skill the crooked vein that descended over this portion of the foot, and also the tendon lying over the tarsal and metatarsal bones. The wound was then squeezed strongly by the assistant, while, with water poured over it and with wads of the cedar bark used as sponges, he washed away the pus and serum that gushed forth, and then with the scraped buckskin stanched the flow of blood.

Having at the outset tenderly admonished their patient, these men seemed thereafter to be oblivious of his agony, to hold in view only his ultimate betterment. And the patient himself seemed almost as oblivious of them, although from suffering his face was drawn and ashen in color, and great drops of perspiration stood on his forehead while his breath came in short quick gasps. Yet he no more changed his grimly set but acquiescent expression than would one of the totem-animals of his ancestry, whose stoicism—as under all circumstances his kind ever do—he sought to emulate. The old surgeons took up one after another of the straight lancets, and with them dissected away the proud flesh and other diseased tissue, removing it cleanly, without severing vein or artery or tendon, until they had fairly exposed the bone itself. Here they found a swollen and diseased bit of nerve or tendon. They ruthlessly cut it out and examined it critically; stuffing some cedar-bark into the wound, they laid their lancets down and discussed thoroughly, and in an interested, leisurely manner, the question as to whether it was already a worm or only a 'becoming' worm. After deciding that whether worm or 'becoming-worm' it was not the chief or sole source of the disease, they laid it carefully aside on some ashes in a hollow potsherd. Then removing the bark and calling upon me to squeeze water into the wound they proceeded until the bone was plainly exposed. They found the periosteum inflamed and discolored, and, therefore, with evident satisfaction, they proceeded to scrape it until every particle of the discoloration was removed. It was claimed that in the substance of the material thus scraped away the deepest source of the disease and 'seat worms' was found. This was also placed on the ashes with the fragment of nerve or tendon. Then one of them took a small fetish, or medicine-stone, from his wallet. It was an ovoid object of banded aragonite, much resembling a ringed worm or maggot. He laid it in the wound. He presently took it out, lifted it aloft with an air of triumph, and carefully placed it on the ashes with the ligament and bone-scrapings. The incision was now held open and thoroughly washed out, and then the chief operator, dipping up gourdfuls of the red liquid, filled his mouth therewith, and repeatedly sprayed the wound by vigorously blowing the fluid into it. All dissected surfaces were then washed, dried with the scraped buckskin, washed and dried again, until it not only became, but actually looked, clean, and was sprayed yet again with the red fluid. Finally, the openings were filled up, or rather stuffed, with the piñon-gum softened by warmth of the breath and in the hands, that were the while kept constantly wet with the red fluid. More of this gum was spread on narrow strips of cloth, and with these the wound was neatly closed as with adhesive plaster. The entire foot was sprinkled or thickly dusted over with the yellow pollen and root-powder, and then bandaged with long strips of the old rags as neatly as it would have been bandaged by a surgeon among ourselves.

The procedure of these primitive surgeons, if we consider the antiseptic treatment involved in their copious sprayings with the willow-bark infusion, in the filling of the wound with purifying piñon

gum and the remarkably effective closure of the incisions thereby, and in the surface-coating with the astringent yellow powder, would certainly seem to have been, almost from beginning to end, as strictly rational also as would have been those of one of our own surgeons. But in reality they were nothing of the sort. If we except the exceeding ingenuity and courage and the anatomic knowledge and skill displayed by these surgeons in their operations, the theories upon which they based their procedure were, from our point of view, irrational in the highest degree. They were a combination of empiric and thaumaturgic modes, chiefly the latter.

These men believed, according to the general philosophy of their people, founded on the superficial appearance of things, that blood—good, fresh, red blood—was the source of 'new flesh.' They believed that when the blood became thinned and black it was weakened and spoiled and must therefore be removed and replaced with fresh blood; that as blood is the source of new flesh, so is water the first source of new blood, of life itself, since nothing can live without water, howsoever abundant sustenance of other sort may be. Therefore, since the willow never lives apart from springs or other continuous sources of water, it must contain within its roots, its sources, the very essence, the very source of life. An infusion of its roots and bark becomes brightly red. It is imagined, therefore, to be the source of new life-blood, of flesh-forming blood itself, and to be effective for the renewal of decaying or 'worm-turning' flesh. The employment of the 'fire-feeding' and, therefore, 'purifying and maturing' piñon gum, and of the cooling and hardening yellow (or 'winter' root) powder and sustaining pollen, also quite, accorded to like ways of reasoning, was as strictly sustained by practical results, and therefore seemed, in turn, to prove the propriety of such reasoning.

They also believed that the violence of the man's injury had so weakened the part injured that it was infested with worms or else was killed and turning to worms. This belief was also based on appearances. Dead flesh putrifies, is filled with pus, or with thin, fluid, black or dead blood, stinks, and is always likely to be, with these people infested with worms (maggots). A festering sore arising from violence, real or imaginary, done to the part in which it occurs exhibits all these characteristics, and, if unchecked, leads to death. Such a sore, if malignant and deep, causes pain as of the bones. Its seed, then, must be deep-seated or in the bones themselves; this seed must be removed, else it will grow and cause death. Any pain like that arising from such a sore, though no sore be apparent, must be caused also by unseen worms or some worm born of violent injury, as by a magical or ghostly arrow.

There remain to be explained two or three of the manifestly irrational operations involved in the procedure. One was the treatment of the pain-causing worm-filament—or diseased nerve—and the ultimate 'source of worm-turning' in the bone they scraped; the other was the use of the maggot-fetish or medicine-stone. The supposedly incipient maggot and the infectious seed-substance of his kind in the bone were placed on the ashes, because fire-ashes are considered, in themselves, to be dissolving and destructive, and (among other quaint reasons) tend toward 'clogging' or 'hindering escape;' for no worm or insect can progress through, or escape from, fine ashes. With the scraping of the bone everything had been done that was humanly possible to remove the infection; but something more must be done, some potency applied, to absorb any remaining infection.

Therefore the fetish-stone, as a sort of spiritual sponge, was introduced.

And I would here enter a plea for the primitive medicine man. He is not usually the arrant knave or juggler so frequently pictured by travellers. His so-called 'tricks' are not attempts at deception. They are solemn operations by which he is himself as much deceived as are any of his witnesses. We are told that these earliest practitioners suck, knead or cut their patients, and end by pretending to find and extract, and by triumphantly holding aloft, some grub, insect or other small object—frequently a minute fetish-stone like the one I have described, that 'they claim' to have actually extracted from the diseased part. We aliens are the only ones of their witnesses who are deceived by them in the way we accuse them of deceiving, for what they really attempt to do is either to expose, or otherwise make as uncomfortable as possible, the animate seat of the disease, and then to furnish it with a decoy, as it were, a vehicle or body of escape, as a killed and squeezed-out body of one of its own kind, or else in the form of its kind as seen in some ancient and more potent and nearly natural object resembling it. Sometimes, again, living insects or worms, or fetishes that are supposed to be living, ravenous and inimical to the worms of disease, are introduced, that they may prey upon and destroy these worms and the seed-substance of their kind. This is especially apt to be the case when thick pus is abundant and parasites are forming; for the squeezed-out pus itself resembles worms more or less, portions of it even in mass, being streaked, seeming to contain their forms in embryo. It, also, is therefore held to be the seed-plasm or substance of worms, and the proof of this is alleged to lie in the fact that, if exposed, like dead flesh, it speedily turns to worms.

The subsequent treatment received by the man whose case I have described, at the hands of his primitive doctors, was quite as much in keeping with this sort of philosophy as had been their operation. His wound was, of course, dressed, cleaned, copiously sprayed, and, I may add, 'Spiritually disinfected,' every day. But, in addition to this, he was put on diet—the freshest or 'newest' possible corn food—and was, for the first four days, deprived of salt (this, too, being abundant in pus-like excreta) and all flesh-food, and was thereafter until perfectly cured—for he recovered with amazing rapidity—denied all meat containg fat and other non-muscular tissue, since these, as well as old and so-to-say 'decrepit' seeds, are supposed to be, of themselves, peculiarly liable to 'worm-turning.'

FRANK HAMILTON CUSHING.
PHILADELPHIA, March 15, 1897.

THE INFLUENCE OF ENVIRONMENT UPON THE BIOLOGICAL PROCESSES OF THE VARIOUS MEMBERS OF THE COLON GROUP OF BACILLI: AN EXPERIMENTAL STUDY.

THE results found in the following pages have been made possible by a grant from the Bache fund of the Smithsonian Institution. The disposal of the grant mentioned is left to the discretion of Dr. John S. Billings and Dr. S. Weir Mitchell. The topic of this research was submitted to these gentlemen at the beginning of the year, and from time to time they have been kept informed of the progress of the work. It is with their approval that this paper is presented for publication. The research of the past year has been a continuation of the studies begun in the fall of 1895, upon the variability of bacteria.

The colon group of bacteria have been chosen for this study, and particular attention has been paid to those forms which appear to be modifications of the typical colon

bacillus which have undergone functional derangement as a consequence of their environment. A short résumé of our experimental work is given in this paper, but we fear that it is insufficient in regard to the details of experiments and the results obtained to maintain our conclusions.

From the observations and deductions of several competent investigators, the pathogenesis of the colon bacillus is due to cultivation in the living fluids of the animal body, which are supplied with an unusual amount of proteid substance by the process of inflammation. We have made experiments with the members of the colon group to ascertain to what extent the proteolytic activity can be increased by growth upon an artificial medium containing large amounts of proteid material. The medium used for our experiment was a bouillon free from sugar and containing a large per cent. of fresh peptones derived from beef muscle by the action of trypsin. These peptones, according to Péré, are capable of forming more indol than those produced by the action of pepsin or any other enzyme.

Series of cultures comprising, severally, the typical colon bacillus, transitional forms of the colon group, and the typical typhoid bacillus, have been carried through a series of cultures in this medium, each culture being changed to fresh media every seventy-two hours, and the old culture tested for indol for the purpose of obtaining an approximate estimation of the proteid digestion.

The result of these experiments was that under these conditions the proteolytic function is increased in activity, so that cultures of the typical colon bacillus gave, in the second generation, after growth for three days in 25 c. cm. of the medium, an indol reaction of a blood-red color in some instances, and requiring in every culture from 10 to 15 c. cm. of a 0.1 per cent. indol solution to give the same depth of color to 25 c. cm. of the sterile medium. Transitional forms of the colon group which have hitherto been supposed to be devoid of the indol-producing power, after cultivation for three or four generations in this medium gave a marked indol reaction. Seventeen different specimens of the typhoid bacillus, obtained by us from some of the best known laboratories in this country, gave also a marked indol reaction after passing through a series of changes in this medium.

Result of excess of one function. The result of the excessive discharge of one function, viz., proteolysis, which has been produced by growth in the fresh peptone bouillon free from sugar, is, first, an increase of the proteolytic activity as shown by the increased amount of indol produced in typical colon cultures, and the production of indol by organisms supposed to be devoid of this property: viz., atypical forms of the colon bacillus, and the typical typhoid bacillus; secondly, after the maximum of indol production is reached, a decrease in proteolytic activity occurs, shown by the lessened amount of indol, and, finally, after several generations, the attenuation and premature death of the organism takes place.

Indol production as an index of pathogenesis. An experiment relating to this question has been carried on for over a year with a virulent culture of the colon bacillus. The culture was tested for indol and virulence as soon as it was isolated. The indol reaction was very marked, and 0.5 c. cm. of a bouillon culture proved invariably fatal to guinea pigs of 500 grammes weight. It was then kept for five months on agar-agar with but few changes, when it was again tested. A faint indol reaction was obtained, and 1 to 2 c. cm. of a bouillon culture was required to kill an animal of 300 to 500 grammes weight. This culture was then placed in the alkali-peptone solution and changed to fresh medium twice in seven days, when tests were again made. The color of the indol reaction was very intense, and 0.3 c. cm. of an

alkali-peptone bouillon culture about twenty-four hours old killed animals weighing from 200 to 300 grammes. This experiment was repeated with the same result, viz., the indol production and pathogenesis were both increased by growth in a medium containing an unusual amount of proteid material so prepared as to be especially suitable for bacterial assimilation. The amount of indol produced by this culture was not greater, however, than is found in other cultures of the colon bacillus which are non-pathogenic. The estimation of the virulence of this organism by the amount of indol formed seems for this reason impracticable.

Cultures from typhoid spleens. We have found by our experiments that the colon bacillus grown in an excess of proteid material in an artifical medium undergoes a disturbance of equilibrium in function, with first an increase of proteolytic activity and later an apparent suppression. Cultures obtained from the pathological tissues of man and animals also present characteristics differing from those of the typical colon bacillus obtained from the healthy colon. For the purpose of demonstrating this modifying effect upon cultures of bacteria belonging to the group under discussion, we have obtained cultures from organs that have been undergoing inflammation for a considerable period of time, viz., typhoid spleens, and have noted their reactions both upon carbohydrate and proteid foods. We have tried to classify these cultures according to these reactions, and with the following results: Cultures corresponding to the typical colon bacillus in reaction have not been found among the cultures studied. A group of cultures were obtained which gave one or more of the prominent reactions of the colon bacillus, and appeared to belong to the transitional series of the colon group. A second group gave the characteristic modifications in function that are found in attenuated cultures of the colon group. A third and larger group gave the reactions of the typhoid bacillus. May not the cultures of the first and second group be colon cultures which have been modified in function by growth in an excess of proteid food?

Our final test for the differentiation of our cultures obtained from typhoid spleens is the serum test, to which the investigations of Widal have recently drawn so much attention that it has become a well-known and popular diagnostic procedure in typhoid fever. We have reversed this test, and have used a specimen of blood which was obtained from a genuine case of typhoid fever, and which had given a characteristic reaction with the typhoid culture used by us for the diagnosis of typhoid fever by the so-called method of Widal for testing our cultures.

The result of this test showed that only about one-third of our typhoid cultures gave what is regarded by us as a positive reaction, although every culture except one showed a distinct agglutination of the bacilli and some degree of cessation of motility. A comparison of the reactions given by the typhoid cultures with those of our cultures from typhoid spleens shows that of 28 cultures derived from typhoid spleens, and giving all the cultural reactions of typhoid bacilli, 18 gave a positive reaction, while 10 did not fulfill the requirements of this reaction in regard to cessation of motion. Two cultures classified as transitional colon cultures gave as typical a reaction as any of the cultures tested.

Our tests upon the series of typical and atypical colon bacilli show that in one culture of each series a reaction was obtained which seemed as striking as any reaction obtained by us with typhoid cultures. Several of the other cultures differed from the control drop by presenting indications of a reaction.

CONCLUSIONS.

Assuming the typical colon bacillus and

the typical typhoid bacillus to represent the types of this group that present the greatest divergences in biological peculiarities, we conclude, as others also have done, that there is a series of closely related forms that may be regarded as intermediate or transitional, and which serve to establish a biological relationship, either near or remote, between these two typical members.

From our own studies we are inclined to regard the typical colon bacillus as the type of this group, for the reason that its functional equilibrium, as observed in the intestine, is so permanent a quality that it may readily be perpetuated under what is ordinarily regarded as favorable artificial circumstances, and that with the continuance of such conditions there is no conspicuous tendency on the part of this organism to deviate from what we regard as its norm; whereas, on the other hand, with all the other members of the group with which we have worked there is not only a lack of uniformity in the adjustment of the functions, but such as exists is readily disturbed under artificial environment, though it must be borne in mind that even with the typical colon bacillus we have also shown functional modifications to be possible under particular conditions.

That when the members of the colon group are cultivated under circumstances favorable to the development of both the function of fermentation and that of proteolysis, fermentation invariably takes precedence and no evidence of proteolysis is manifested until after fermentation has ceased.

That the cultivation of all the members of the colon group under circumstances that favor the development of one function, viz., that of proteolysis, at the expense of another, viz., that of fermentation, results first in apparent increase of vigor; but this is of temporary duration and is quickly followed by the decline and death of the cell.

The result of this increased activity of the proteolytic function is the formation of much larger amounts of indol by typical colon cultures than has ever been obtained by us by any other method.

By the method of experimentation through which we were enabled to accentuate the proteolytic activity of the typical colon bacillus, as caused by an increase of indol formation, we have also induced the function of indol formation not only in atypical colon bacilli that have been devoid of it but in every specimen of typical typhoid bacilli to which we had access as well.

We feel justified in regarding one of the differential tests between the typhoid and colon bacillus, notably that of indol formation on the part of the latter and the absence of this function from the former, as of questionable value, for the reason, as shown above, that by particular methods of cultivation indol production has been shown to accompany the development of a number of specimens that we have every reason to regard as genuine typhoid bacilli.

As a result of our own experiments, together with the observations of others, there can be no doubt that the bacillus *coli communis* at times possesses pathogenic properties, and that by artificial methods on treatment it may often be brought from a condition of benignity to one of virulence,

The spleen of a typhoid patient has always been regarded as the only trustworthy source from which to obtain the typical typhoid bacillus. While we believe this to be true, still our investigations show that other members of the colon group may also be present in this viscus; in fact, from such spleens we have isolated practically all of the varieties of this group with which we are acquainted.

From our experience the value of the serum test for the differentiation of typhoid and colon bacilli would seem to be questionable. We are inclined, however, to attribute the irregularities recorded above as

due more to the method of application than to defects of the principles involved; for, as stated, by the use of dried blood, as in our experiments, it is not possible to make the test with constant and accurate, or even approximately accurate, dilutions of the serum. Our irregularities may be in part due to this defect. We therefore lay less stress upon this than upon the other features of our work.

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THE VIRGINIA COLONY OF HELIX NEMORALIS.

THE now well-known colony of the European *Helix nemoralis* at Lexington, Va., has twice before been the subject of articles by the present writer. (*Nautilus*, November, 1889, and December, 1894.) It was shown in these articles that many new variations, different from those observed in Europe, had occurred; and the colony consequently became of great interest to students of evolution. Unfortunately, Professor Morrison, who was studying these snails, removed from Lexington in 1890, and, having the misfortune to lose his collection by fire, paid no further attention to the matter. It is only now that I am, through the kindness of Mrs. John M. Brooke, of Lexington, in a position to give some account of the colony subsequent to the date mentioned.

In order that every reader may understand what follows, I will explain the system of band-formulæ used for recording the variations. The typical shell has five bands and the formula is 12345. The absence of a band is indicated by 0, thus 10345. Two or more bands united are bracketed together as (12)345. A rudimentary band is expressed by a small figure below the line, as $1_{2}345$. A split band is expressed by doubling the number, as 123345. An extra band, not assignable to any of the normal five, is expressed by a ×, as 123×45.

Mrs. Brooke sends me a series of shells gathered by herself at Lexington in 1896 and 1897. They are as follows:

A. With a yellow ground-color = *libellula*.
libellula 12345.....70.
" 123(45).....21.
" 10345.....10.
" $1_{2}345$ ..... 9.
" 12045..... 6.
" 00000..... 5 sent, but Mrs. Brooke says they are plentiful.
" $12_{3}45$ ..... 4.
" $_{1}0345$ ..... 3.
*" $12_{3}3(45)$ nov. formula.. 2, the formula shows only near the mouth of the shell.
" $_{12}345$ ..... 2.
" (123)(45)..... 2, juv.
" (12)3(45)..... 2, one is juv.
**libellula* $(12)_{2}3_{34}45$ nov. formula,..1, the formula shows only near the mouth.
" $12_{3}3(45)$ .....1.
" 00345.....1. juv.
" $1_{2}045$ .....1.
" 02345.....1.
" $123_{xx}(45)$.....1.
" 00300.....1.
" $_{1}0300$..... .....1.
" 123_{x} (45).....1, juv.
*" $_{1}(22)045$ nov. formula..1.

B. With fawn-colored ground = *petiveria*.
petiveria 12345.....1. = *brissonia*, Moquin-Tandon.
" 123(45).....1. = *arcelinia* Locard.
" (12)3(45).....1. = *brookea*, n. n.

C. With pink ground = *rubella*.
rubella 00000.....2. Quite pale. Mrs. Brooke says they are extremely scarce.

The three forms above marked with an asterisk are new to the Lexington list, and are all new formulæ of the split-band type, like the previously found new variations in the colony. All of the rest were formerly obtained by Professor Morrison.

The examination of the above list brings out the apparent fact that the new split-band variations are now comparatively rare in the colony, though still much more fre-

quent than such forms are in Europe. On the face of things, it certainly appears as if the colony were reverting to the European type. At the same time, it must be remembered that Morrison's remarkable variations were picked out of a very large number of shells—a far larger number than those sent by Mrs. Brooke. Unfortunately Professor Morrison never published the detailed statistics he had accumulated, but from data he sent me I gather that there were about 100 split-band shells to 2100 others, *i. e.*, about 4.8%. The split-band forms in Mrs. Brooke's lot above are about 4%, and are not nearly so remarkable as many of Morrison's. But Mrs. Brooke probably put aside the best variations; in fact, she sends for my inspection the following, taken by her at Lexington at various times, and new to the list for that locality, three being new formulæ:

rubella 12045. I have taken a young example of this in England—at Beckenham, Kent. The formula was recorded before from Lexington with a different ground-color.

rubella 003_40. The formula was recorded from Europe by Roebuck.

" 10045. Very pale ground color. A new combination.

petiveria 1 (23)(45). = *goupilia* Moquin-Tandon Also in France.

" 00305 = *gabillotia*, Locard. Also in France.

" (1$\dot{2}$3)(45). = *lowea*. Moquin-Tandon. Also in France, England and Ireland.

" 1(23)(45).

libellula $00(3^x)00$. nov. formula

" 00305 = *bruguieria*, Moquin-Tandon. Also in France and England (Kent).

" $(12)_53(33)3(45)$ nov. formula. This is the most remarkable shell sent by Mrs. Brooke. It seems to have been found dead, and so may date back to earlier times.

" 003055. The formula has been recorded from Europe by Kreglinger.

" $(12)_x$ 3(45) nov. formula.

While the percentage of split-band forms may seem small, European collectors will appreciate their *relative* abundance in the Virginia colony, and the large number of different formulæ in the latter which have not yet been seen in Europe. Very many more split-band formulæ are now on record from the Virginia colony than from the British Islands all together, notwithstanding the collecting that has been done in the latter country.

I regret that it is not possible to definitely assert as yet whether the peculiar variations of the Virginia colony are losing ground, but such seems to be the case to a slight degree at least. Certainly there is no evidence of their increase. Probably Mrs. Brooke will be able at a later date to give us more conclusive statistics.

The reader will observe the names (as *goupilia*, *lowea*, &c.) given to the different combinations of color and banding. These were first introduced by Moquin-Tandon; and many were added by Locard, but a very large number of combinations have no such names. I find that they are rather useful, as they can be remembered better, and are not so easily written or printed wrongly as the formulæ, etc., they represent. If I were writing a large treatise on the variation of *H. nemoralis*, I should be inclined to prefer names to formulæ when discussing distribution and other matters.

The colony of *H. nemoralis* at Burlington, N. J., is very different from the Virginia one, and so far as known contains nothing peculiar. Specimens sent to me by Mr. W. G. Binney belonged to *rubella*, *guettardia* and *cuvieria*.

T. D. A. Cockerell,
N. M. Agr. Exp. Sta.
Mesilla, N. M., April 20, 1897.

CURRENT NOTES ON METEOROLOGY.

NAVIGATION IN FOG.

A paper by Prof. E. C. Pickering, on

'Navigation in Fog,' contains some interesting suggestions regarding the possibility of determining the distance and direction of one vessel from another in a fog by means of a calculation based on the velocity of sound. If, for instance, two fog horns, A and B, are placed, one east and one west of a given point in a north and south channel, and each two miles distant from the point, and these horns are blown simultaneously and automatically at regular intervals of about a minute, a captain who is trying to work his ship through the channel can readily get his bearings. Supposing that one horn has a higher pitch than the other, and that a vessel is one mile east of the channel between the two horns, the captain of the vessel will hear the high-toned whistle A five seconds after it is blown, because it is only one mile distant, but B will not be heard for 15 seconds, since it is three miles off. If both horns are heard together the vessel is in the middle of the channel. Another application of this same method of determining positions of vessels is suggested in the case of one vessel attempting to pass another in a fog, and in the case of the calculation of a ship's distance from shore when the ship's time is within a second or two of that on shore, and when a whistle on shore is blown at the exact beginning of each minute. The determination of the velocity of the wind is also noted as being a useful application of this same method, especially in the case of very high winds, which are apt to injure anemometers. Professor Pickering's suggestions are worthy of serious consideration.

HYDROGRAPHIC OFFICE CLOUD TYPES.

THE Hydrographic Office of the Navy has issued a set of colored cloud views, classified according to the international nomenclature, for the use of its observers at sea. There are twelve different views, printed on one sheet, the whole sheet measuring 23 x 28 inches, and the individual pictures $3\frac{7}{8}$ x $5\frac{1}{4}$ inches. These cloud types are not reproduced from photographs, but from paintings. The set is an admirable one, some of the cloud forms being even more typical than those in the new Cloud Atlas, while the reproduction of the pictures of the original views gives several of the pictures a more natural appearance than the corresponding forms have in the Atlas. The alto-stratus, which in one of the views in the Atlas is yellowish, has its proper color of grayish-blue on the Hydrographic Office sheet. The price of the sheet is 40 cents. The views are also published on separate pages, with descriptive text, bound, and cost 60 cents in that form.

RECENT PUBLICATIONS.

On Obtaining Meterological Records in the Upper Air by Means of Kites and Baloons. A. L. ROTCH. Proc. Amer. Acad. Arts and Sciences, Vol. XXXII., No. 13, May, 1897. 8vo. Pp. 245–251.

An account of the kite work at Blue Hill Observatory and of the ascents in Europe by means of 'ballons sondes.'

Difference in the Climate of the Greenland and American Sides of Davis' and Baffin's Bay. R. S. TARR. Am. Journ. Sci., Apr., 1897. Pp. 315–320.

The Greenland side has the milder climate, owing to ocean currents and winds.

Meterologie. W. GRABERT. Leipzig, 1896. Small 8vo. Pp. 149.

Although much condensed, this new text-book is well written and presents the newest theories and facts.

NOTE.

Owing to the departure of the compiler of these notes for a somewhat extended scientific tour in South America, the regular publication of the *Current Notes on Meteorology* will be suspended during the next six months.

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CURRENT NOTES ON ANTHROPOLOGY.

THE ANTIQUITIES OF BORNHOLM.

BORNHOLM is an island in the Baltic sea, about 23 miles long, under the government of Denmark. A study of its antiquities has been published at Copenhagen this year by E. Nedel, a continuation of his previous publications (Efterskrift til Bornholms Oldtidsminder, quarto, pp. 166. Illustrated).

This local study has a general interest not merely for the abundant material it presents for comparison, but for the very regular superposition of archæologic layers it reveals, from an early stone age through the bronze age and the first and second iron ages. The earlier stone relics are cutting instruments of an extremely primitive model, where the cutting edge is produced by the natural cleavage of the stone without any attempt at chipping or rubbing. It is not clear from the text whether a stratum was found containing these exclusively, as it is well known such *teshoas*, as they are called in American archæology, occur in all periods.

These researches do not carry the antiquity of man in the locality beyond the manufacture of pottery and the domestication of animals, therefore not beyond received dates. The volume is handsomely illustrated and a fine example of antiquarian work.

THE CHACO TRIBES.

ATTENTION has been called several times in these notes to the studies of Lafone Quevedo on the ethnography and dialects of the tribes inhabiting the Gran Chaco. In a private letter received from him recently he remarked that the problem of the relationship of the Chaco languages is now virtually solved, although some corners of the area remain a little obscure from lack of material.

The languages are divided into two great groups, morphologically distinct, the one expressing the grammatic relations by suffixes, the other by prefixes.

I. Suffixal group.
   1. Lule (extinct).
   2. Vilela (or Chulupi).

II. Prefixal group.
   1. Abipone.
   2. Mocovi.
   3. Toba.
   4. Mbaya (and probably Mataco, Payagua and Lengua).

The prefixal group belongs to the great Guaycuru stock, as I have classed its members in my 'American Race,' p. 315.

A large amount of linguistic material has been collected by Lafone Quevedo, and it is to be hoped that it will soon be published for the benefit of the scientific world.

THE CELTS AND THEIR WANDERINGS.

THIS question has been several times discussed in these notes, and, as it is a primary one in European ethnography, it is well to quote, from the 'Centralblatt,' the results of the latest studies presented in an article of H. Mollier, of Lyons.

Five hundred years B. C. the Celts possessed central Europe, from the Rhine to the Danube, and from the North Sea to the Alps. About a hundred years later, pressed by Germanic tribes on their north, two streams of migration poured out from them—the one into Italy, Illyria, southern France, northern Spain, and northern Britain; the second, continuing several centuries, into Belgium, northern France and southern Britain.

The primitive physical type of the Celt was tall in stature, skull dolichocephalic, hair blonde and complexion fair. The fact that the southern branch, especially in France, so widely departed from this, was owing to their constant intermixture with the Ligurians, who are supposed to be non-Aryan, and other peoples descended from the ancient dwellers in the stone age. The primitive Celts were, of course, closely allied

with the primitive Germans. Broca's Celtic type is in fact Ligurian, and the Galatæ were true Celts, with the original blonde traits.

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SCIENTIFIC NOTES AND NEWS.

THE Senate Committee on International Expositions has reported a bill providing for the representation of the United States at the Paris Exposition of 1900, and recommending an appropriation not to exceed $500,000. As reported, the bill provides for a Commissioner-General at a salary of $10,000 a year, an Assistant Commissioner-General at $6,000, and ten scientific experts at $2,500 a year each.

A BIOLOGICAL station containing aquaria, laboratories, rooms for collections and library is in course of erection near Sebastopol, on the Black Sea. It is expected that the building will be opened for scientific work during the present year.

THE third circular issued by the general committee of the Seventh International Geological Congress recommends that special attention be given to a unification of geological and petrographic nomenclature. The guide to the excursions is expected to appear immediately, and will extend to about 500 pages, with many maps and illustrations. The free tickets on the railroads will be valid from July 22d to October 17th. It is stated that university students cannot take part in the excursions, but there will doubtless be accommodation for all geologists. The excursions to the Ural regions and to the Crimea are each limited to two hundred persons.

ACCORDING to the New York *Medical Record* the following are the names of those who have been invited to deliver orations at the general sessions of the Moscow Congress: Lauder Brunton, of London, on the 'Relationship between Physiology, Pharmacology, Pathology and Clinical Medicine;' Nicholas Senn, of Chicago, on the 'Diagnosis and Surgical Treatment of Acute Forms of Peritonitis;' Krafft-Ebing, of Vienna, on the 'Etiology of Progressive Paralysis;' Danilevski, of Khartov, on 'The Action of Electric Rays on the Animal Organism at a Distance;' Lombroso, of Turin, on 'New Horizons in Psychiatry;' Leyden, of Berlin, on the 'Present Modes of Treating Consumptives and their State Control;' Herzen, of Lausanne, on the 'Significance of Physiological Psychology for Medical Education. Robert, of Barcelona, and Lukianov, of St. Petersburg, have not yet announced the titles of their addresses. Virchow, of Berlin, and Roux, of Paris, have been invited to deliver orations, but no word had been received from them by the Moscow committee at the time the above announcement was made.

PROFESSOR M'KENDRICK, of the University of Glasgow, has been awarded the MacDougall-Brisbane prize by the Royal Society of Edinburgh in recognition of his published researches in connection with sound and the phonograph.

DR. HADDON has been granted £300 from the Wort's Travelling Scholars' Fund, of Cambridge University, for an anthropological expedition to the Torres Straits.

PROFESSOR VIRCHOW is at present at Brünn, engaged in examining the prehistoric remains in the neighborhood.

IT is reported that Mr. Edward McIlhenny, accompanied by Mr. W. E. Snyder and Mr. Norman G. Baxton, proposes to leave San Francisco on June 25th for Point Barrow, Alaska. He expects to spend two years making collections of the fauna and flora of northeastern Alaska. It is said that the collections are for the National Museum and the University of Pennsylvania.

DR. FRITZ MÜLLER, the botanist, died at Blumenau, Brazil, on May 21st, at the age of 76 years. Dr. J. Lewis Smith, formerly clinical professor of the diseases of children in the Bellevue Hospital Medical College, and the author of many contributions to this subject, died in New York on June 11th, at the age of 69 years. M. Leopold Maney, correspondent of the Paris Academy for geography and navigation, died in May.

THE works of Alvan G. Clark & Sons will be continued under the supervision of Mr. Carl Ludlin, who for twenty-five years has been engaged as a maker of lenses under the firm.

THE Board of Trustees of the University of Rochester have sanctioned the establishment of

a fresh-water biological station at Hemlock Lake, under the direction of Professor Charles W. Dodge.

An International Congress of Librarians will be held in London from 13th to 16th of July. Dr. Melvil Dewey will be one of the representatives of the United States government.

There has recently been opened at the Crystal Palace an exhibition in commemoration of the Diamond Jubilee of Queen Victoria, in which the progress made by science during the reign is said to be well represented.

The Rev. Professor Wiltshire has presented his valuable geological library, containing about 1,500 volumes and pamphlets, to the Woodwardian Museum, Cambridge University.

The Drapers' Company has offered to erect a new building for the accommodation of the Radcliff Library at Oxford, at a cost of £15,000.

The library building of the University of Iowa was struck by lightning on June 19th and destroyed by fire. The physical laboratory was on the first floor of the building. The total loss is estimated at $100,000.

The second 'International' *Congrès olympique* will be held at Havre during the last week of July. The subjects to be discussed are physical exercises and games in their relation to pedagogy and hygiene.

A Röntgen Society was inaugurated in London on June 23d. Professor Sylvanus P. Thompson was elected President, and forty-four members were enrolled, of whom about one-half were made officers.

The *Academy* states that the third part of the late George John Romanes' 'Darwin and After Darwin' is in the press. The subject-matter consists of post-Darwinian questions, Isolation and Physiological Selection.

A number of Swedish zoologists have prepared a volume of contributions to zoology as a *Festschrift* on the occasion of the eightieth birthday of Dr. Wilhelm Lilljeborg.

The annual visitation of the Royal Observatory at Greenwich took place on June 5th, and the Astronomer Royal submitted his annual report for the year ending May 10th.

As we have announced, a census of the Russian Empire was taken on February 9th, none having been taken since 1851. The total population is now given as 129,211,113, having about doubled in a period of forty-six years.

At the annual general meeting of the Victoria Institute on June 2d, Lord Kelvin made an address on the 'Age of the Earth as an Abode fitted for Life.' Lord Kelvin maintained the position taken by him thirty years ago, that this earth could not have been a habitable globe for more than thirty million years.

It is reported that Professors Koch's antitoxin treatment for the rinderpest has proved to be of no value. Nine-tenths of the cattle north of Cape Colony have been exterminated, and it is feared that Cape Colony will fare no better. There is great mortality from fever in the region, supposed to be due to pollution from the numbers of cattle which have died from rinderpest.

The *British Medical Journal* states that at the conference of Ministers of Agriculture representing the Australian colonies, recently held at Sydney, it was decided that the colonies combine in offering a reward of £5,000 to any person who discovered and made known a satisfactory remedy for the tick disease which has caused so much destruction amongst cattle.

The New York *Independent* addressed a number of 'representative' men and women, asking what, in their opinion, was most characteristic of the period of Queen Victoria's reign. As might be expected, the replies differ greatly, one holding it to be the growth of democratic politics, another the security that has been given to the monarchy, one the grinding, bleeding system of rule in India, and another the growing attachment between the mother country and her colonial empire; but one-half of those who reply, including such diverse points of opinion as those of President Eliot and Madame Patti, hold that the most important characteristic of the past sixty years is the progress of science and its applications. In the same number of the *Independent* there is published an admirable article by Professor Newcomb on 'Science during the Victorian Era.'

THE General Secretary of the Italian Geographical Society asks us to contradict the report that Dr. Nansen did not lecture at Rome because the Society was unable to pay the expenses. The Society conferred upon Dr. Nansen its great gold medal, a silver medal on each of the officers and a bronze medal on each of the men. Dr. Nansen, in a letter from Christiania (April 21st), expressed his thanks for the honor, and his regrets for being unable to go to Rome to receive them, as he should have liked very much to do had his time allowed, as he hopes it will on some later occasion.

THE plans of operation for the United States Geographical Survey for the ensuing year, which were formulated by Director Walcott as soon as the Sundry Civil and Indian Appropriation Bills became laws, have been approved by the Secretary of the Interior, and the Survey's work in the several branches for the field season of 1897 and the fiscal year is now under way. Following is a synopsis of the sums appropropriated for the Survey in the bills named and the purposes for which they are used: For topographic surveys in various portions of the United States the Sundry Civil Bill carries $175,000; for geologic surveys and researches pertaining to the geology of the country, $100,000; for the continuation of the investigation of the gold and coal resources of Alaska, $5,000; for paleontologic researches, $10,000; for chemical researches, $7,000; for gauging streams and determining the water supply of the United States, $50,000, and for the annual report of the mineral resources of the United States, $20,000. There are also in this bill the usual allowances for engraving and printing, preparing illustrations, etc. In addition to these items, which relate to lines of work already under way and carry the same sums as are carried in the bill for the present year, there are in the Sundry Civil Service bill just passed provisions for new or special work as follows: For surveying the public lands designated by Executive order as forest reserves, $150,000, and for surveying the boundary line between the States of Idaho and Montana, $7,650. In the Indian bill there is an item for completing the topographic and subdivision surveys of the Indian Territory, $100,000. This has reference to the survey of the lands of the Choctaw, Creek and Cherokee Nations, which was begun in April, 1895. There is also in the same connection provision for the resurvey of the lands of the Chickasaw Nation, in the same Territory, $141,500, or in all for the Indian Territory surveys, $241,500. Of the provisions for new work above mentioned, the only one that is of special importance is that relating to the survey of the public lands designated by the President as forest reserves. This provision grows out of the prolonged contest in Congress on the subject of the disposition of the forest areas of the West, and the question of abrogating or modifying President Cleveland's order of February 22, 1897, setting aside a number of forest reserves. Congress suspended certain of these great reserves and the work is to be confined to these. There is to be a topographic and subdivision survey, followed by a survey of the forest areas. The appropriation for this work, like the appropriation for most of the Survey work, was made immediately available, and the work will not have to wait until July 1st. The delay in the passage of the appropriation bills will have the effect of shortening the field season of the Geological Survey a month or two and, it is presumed, will somewhat curtail the output of work, at least in some directions. The Indian Territory survey, which has been going on in the field and in the office all the year round since it was commenced, has suffered quite appreciably, it is understood, owing to the peculiar conditions governing it. The appropriation for this work for the year 1896–97 was practically exhausted in April, and for two months the work was under suspension.

PROFESSOR EDWARD L. NICHOLS, President of the New York State Science Teachers' Association, has, in accordance with the vote of the Association at its last meeting, appointed a committee of nine to consider and report at the next annual meeting on the following topics: (1) Science as an Entrance Requirement to Colleges; (2) Science Teaching in the Secondary Schools; (3) Nature Study in Primary Schools. The following are the members appointed: Leroy C. Cooley, Chairman; Albert L. Arey, George F. Atkinson, Anna B. Comstock, Rich-

ard E. Dodge, William Hallock, Charles B. Scott, Ralph S. Tarr, John L. Wilson.

We learn from *Natural Science* that the sixth meeting of the *Nederlandsch Natuur en Geneeskundig* Congress, corresponding to the American and British Associations for the Advancement of Science took place at Delft, on April 22d, 23d and 24th. The general President was Professor J. M. Telders, and the five sections were presided over respectively by W. A. van Dorp, of Amsterdam; W. Kapteijn, of Utrecht; P. P. C. Hoek, of Helder; H. Treub, of Amsterdam, and K. Martin, of Leyden. The sectional meetings were held in the various laboratories and lecture-rooms of the Polytechnic School, in both morning and afternoon. Several of the sections had very attractive programs; among the most interesting papers in Section II. (Biology) may be mentioned one by Professor Hubrecht on 'Primates and Lemurs,' and one by M. C. Dekhuijzen, of Leyden, on methods of investigating the micro-organisms in fresh water. The Section for Physics and Chemistry had an able paper by Col. C. F. Geij van Pittius, on various explosives, and one by H. A. van Ijsselstein on an interesting form of telephone. The paper which formed the last of the series on Saturday was of special interest, a lecture by Professor M. W. Beijerinck, on luminous bacteria.

UNIVERSITY AND EDUCATIONAL NEWS.

It is rumored that a union between New York University Medical School and the Bellevue Hospital Medical College will not be carried into effect.

The name of the Maine State College at Orono has been changed to the University of Maine.

Dr. J. L. Goodnight, who has been President of the West Virginia University, at Parkersburg, for two years, and Dr. J. A. Myers, who has been Director of the State Experiment Station for nine years, have been removed by the Board of Regents of the University. It is said that this action is due to political reasons.

Dr. James Woodrow, on reaching the age of seventy years, has resigned the presidency of South Carolina College. President Craighead and Professors Tompkins and Wright have resigned from Clemson College. President Craighead has been elected President of the College of Wisconsin. Dr. W. H. Hervey has resigned from the presidency of the Teachers' College, New York.

Professor A. C. Armstrong, now professor of philosophy at Wesleyan University, has been appointed to a professorship in the department of history in Princeton University. E. M. Weyer, of the University of Leipzig, and M. Matsumoto, of the University of Tokio (Japan), have been made assistants at the Yale Psychological Laboratory. Mr. Muir, now of Halifax University, has been appointed to the chair of psychology in Mount Holyoke College.

The American Society for the Extension of University teaching offers at the University of Pennsylvania a summer meeting from July 6th to 30th. Thirty-eight lectures are announced, and many of the courses will prove of scientific interest. Conferences on the teaching of geography will be led by Professors W. M. Davis and R. E. Dodge. Professor W. F. Magie will give two lectures on Mediæval Science. Professor J. T. Rothrock will lecture on forestry and Professor W. P. Wilson on Museums. In psychology, courses of lectures are announced by Professor Lightner Witmer, Professor J. Mark Baldwin, Professor E. B. Titchener, Mr. R. P. Halleck and Miss Laura Fisher.

The New York Board of Education has announced the courses of study for the three new high schools which will be opened in September. Three courses are offered—classical, commercial and general. The first mentioned fills the requirements of the classical courses in the colleges and includes five hours in physics or chemistry in the fourth year. The commercial course requires two hours in physiology and four hours in biology in the first year and three hours in physics in the second year. The general course offers a larger number of electives. A student can take four hours in science in the first year, seven in the second, four in the third and four in the fourth. It is not clear to us why the student in the third year may take fifteen hours in languages and in the fourth year nineteen, while he is confined to four hours in science.

DISCUSSION AND CORRESPONDENCE.

IS THE LOESS OF EITHER LACUSTRINE OR SEMI-MARINE ORIGIN?

TO THE EDITOR OF SCIENCE: Mr. Hershey, in your issue of May 14th, urges anew the claims of the lacustrine and submarine hypotheses for the origin of that still problematic deposit, the loess. The former has been considered for the last forty or fifty years, and the barrier has not yet been found to separate it from the sea. The latter has been discussed for twenty-five years or more, and no trace of marine fossils have yet been found to corroborate it, though if it were true nothing would seem easier.

The undersigned committed himself to the lacustrine view in 1875 by naming a hypothetical lake covering the loess of western Iowa and Nebraska, Lake Missouri.* Even as late as 1891† he argued for a similar body of water for the deposition of the extramorainic drift as well as of the loess of the same region. But a study of Lake Agassiz and of Lake Erie satisfied him that the position was untenable. Perhaps the strongest reason for changing his opinion was the absence of all shore lines, like beaches or cut slopes. These are a conspicuous feature in the cases studied, but none have been found connected with the loess. When we think how a single storm builds a beach ridge sometimes on the shores of lakes no larger than the one postulated; when we remember, also, how little eroded much of the plateau of northern Missouri seems to be, we can accept neither his suppositions that they may have been entirely removed by erosion, nor the still more improbable one that no beaches were formed, "because the shore line did not remain at one level a sufficient length of time." In his appeal to western Florida as an instance of the latter case he admits that the surface is 'undulating,' which rouses the suspicion that a more comprehensive study of it would prove that character to be the result of beaches much eroded, though probably modified by dune action, and possibly by solution of the underlying rock.

He refers to a deposit which he has observed 1,000 feet A. T. between Cuba and Pacific City, Mo., as closely resembling the 'upland loess' of northwestern Illinois. Before we admit the extension of a loess-depositing gulf to that altitude—for such a body of water as would cover that and the clayey loam of Illinois could not have been separated from the ocean—let us consider some of the things involved in such a view. It involves the submergence of St. Louis 500–600 feet, of northern Illinois nearly the same, unless there was an elevation in that direction instead of a greater depression, as has been more commonly argued. It implies strong wave action, especially around the Ozark uplift. It implies remarkably discriminating erosion to have removed so completely the loess and drift from the nooks of that irregular shore, when it failed to do so from the slopes and summits almost overhanging the gorge of the Missouri in Boone county, Mo., or that of the Mississippi, in Pike county.

Before entertaining so violent a supposition, why not refer the Cuba deposit to some local lake, such as may be found in any residuary area, or to an 'adobe' formation, or to 'æolian loess,' which no doubt accumulates in many localities to moderate thicknesses.

Moreover, the gulf theory demands that the sea submerged points, 1900–2000 A. T. in northeastern Nebraska, and 1300–1400 in northeastern Iowa. And this, too, in regions which shortly before and not long after had vigorous streams flowing at considerably lower levels.

Against the fluvio-lacustrine or flooded river theory for the Missouri 'upland loess' Mr. Hershey presents the objections, first, that it was 'laid down on an undulated upland, dissected by valleys,' and second, the 'inequalities, when considered over broad areas, of the surface of the sheet of loess or loam.' The former must be more or less true in any superimposed drainage. And any alluvial plain is far from even or level. The delta of the Mississippi has a general slope toward the sea of eight inches to the mile, with local slopes for a few miles five times as great. The fluctuations of water level have a range of 50 feet or more in some places. Moreover, when we become acquainted with the habitual creeping, or glacier-like, movement of clays and

* Proc. A. A. A. S., 1875.

† Proc. Iowa Acad. Sci., 1891, p. 5, and Am. Geol., 1892.

loams, it does not seem so incredible that the loess and clayey loam are the delta-like accumulation of great streams, fed from the glaciers on the north and the Tertiary silts on the west.

I am surprised to learn from Mr. Hershey's letter that in northwestern Illinois the 'upland loess' 'is present over the thick terrace-like deposits of true loess down along the streams.' Chamberlin and Salisbury, as I understand, make the terraces *subsequent* to the former, and however that may be in that region, there is clear evidence from fossils and rearranged material that such is the case along the Missouri. It is a common thing for all terraces to be capped by a finer loam, the last deposition of the flood which laid down the coarser material below, or of some subsequent flood which barely submerged them.

Mr. Hershey assumes without question the preglacial age of the troughs of the Missouri and Mississippi through this region. This has not yet been proved. The evidence to the contrary is given at some length in my report which he reviewed, and I need not repeat here. I would add only a few words. The rock bottom of the Missouri through the State of Missouri, and of the Mississippi below the mouth of the Des Moines, is nowhere known to be lower than is known to be sometimes reached by 'the scour' in floods of the present day, viz., 80 or 90 feet.

The interesting preglacial channel west of Keokuk, first reported by General Warren, is interesting, but instead of proving that most of the present Mississippi channel is preglacial, rather shows the contrary, for its course at Quincy and below corresponds in depth and size with the new channel at Keokuk rather than the old one, and that has evidently been cut since the glacial epoch. We may as reasonably search for the continuation of the old channel toward the east as toward the south, for bed rock opposite Quincy is 45 feet below low water.

Before closing I would state that I am not over-confident concerning the Osage-Gasconade divide, and am only sorry that circumstances have not permitted my further study of the problems involved. But as far as our present knowledge goes, it still seems to me much more tenable than the theory which I understand Mr. Hershey to propose.

J. E. Todd.
State University, Vermilion, S. D.,
May 31, 1897.

A MONUMENT TO THE LATE BUYS-BALLOT.

To the Editor of Science: The Royal Dutch Meteorological Institute is about to remove from the old buildings at Utrecht, where, during forty years Professor C. H. D. Buys-Ballot labored so indefatigably for meteorology, to the new establishment at de Bilt, near Utrecht. Buys-Ballot, who may be called the founder of meteorological science in the Netherlands, is known to students of that science the world over from the law bearing his name, which connects the direction of the wind with the position of the storm center. His noble character, combined with a charming personality, endeared him to his colleagues, and won the respect and affection of a wide circle of acquaintances, which included the writer. A provisional committee, composed of his former associates, believing that the memory of such a man is honored outside of his own country, has invited an international committee to aid in obtaining funds for the erection at Utrecht of a monumental bust of the great meteorologist. The American members of this committee are Professor Willis L. Moore, Chief of the United States Weather Bureau at Washington, and the undersigned. Subscriptions sent to either one of us will be acknowledged and forwarded to the Dutch committee.

A. Lawrence Rotch,
Director of the Blue Hill Meteorological Observatory, Readville, Mass.

ORGANIC SELECTION.

I am unable to agree with Mr. Robert M. Pierce that the passage he quotes from Mr. Herbert Spencer's 'Principles of Biology' sets forth the same conception that Professor Mark Baldwin dealt with in Science for April 33d. Mr. Spencer's position, I take it, is this: Acquired characters are inherited; there is a natural selection of acquirers, the fittest of whom survive to transmit their acquired characters; hence evolution is rendered more rapid than it would otherwise be. This is primarily

Lamarckism, with natural selection as 'a secondary agent,' and as such it differs widely from the hypothesis with which Professor Mark Baldwin is concerned.

C. LLOYD MORGAN.

UNIVERSITY COLLEGE, BRISTOL, ENG.

SCIENTIFIC LITERATURE.

A Treatise on Rocks, Rock-Weathering and Soils. By GEORGE P. MERRILL. New York, The Macmillan Company. 1897. Pp. 411. 25 pls., 42 figs. in text. $4.00.

Professor Merrill is already known to the public as the author of 'Stones for Building and Decoration,' of a guide to the geological collections of the United States National Museum, and to geologists as well by his valuable contributions to the subject of rock-weathering. The present work is a résumé of his own investigations of rock disintegration and decomposition rounded out by an abstract of the literature of the subject. The book is a welcome addition to the already numerous aids to the study of rocks. It is particularly important in its bearing upon the sedimentary rocks and the soils which have not as yet received the careful examination which has been bestowed upon the igneous rocks.

The author's plan is in its outlines simple and logical. The igneous rocks are treated as what may be termed original rocks, from which all others are derived. Following them is a description of the metamorphic, vein and clastic rocks. After this is given the manner of disintegration and decomposition of these rocks. In general, the text follows a natural cycle of change in those rocks which are exposed to the direct action of the atmosphere and surface processes.

Unfortunately, the details of the plan have led to much repetition of subject-matter, which might have been avoided by a little attention. This duplication is particularly brought to mind by the similarity of the phrase when it appears. Thus we read in regard to slaty cleavage:

P. 155. In such cases the bedding is not infrequently indicated by the dark bands or 'ribbons' which are so evident on a split surface.

Again:

P. 171. In such cases the true bedding plane is often determined only by the dark bands, or ribbons, by which the split slates are traversed.

Eskers and kames are described on p. 290 and again on p. 356 in essentially the same words.

Some terms are used before they are explained, as, *e. g.*, metamorphism, in the introductory chapter. This is particularly noticeable in the notes upon the occurrence of minerals and from the pedagogical standpoint is a defect in the book. Furthermore, it is redundant and unnecessary, since the information is given again in its proper place in the chapter on rocks.

A few passages in the text are so clearly ambiguous as to be explained only on the ground of careless proof-reading. Thus, on p. 108, there is the meaningless statement concerning the manganese oxides, "which, though wide in in their distribution, are found in such abundance as to constitute rock masses in comparative rarity."

Again, on p. 36, we read of concretions "which may not so closely simulate animal forms as to be very misleading." *Often* for *not* in this sentence would bring the statement into the realm of the understanding. More blind yet is the statement on p. 236 that "oligoclase always gave way before the oligoclase."

There are several other slips which one may expect to find in a first edition, as, on p. 64, the phrase 'apparently evident,' and on p. 292, "where the included débris is deposited on melting," the context shows that we should read 'on the melting of the ice;' on page 163 we find *Eozoon Canadenses* for *Eozoon Canadense*, elsewhere correctly given.

On p. 393 the reference to the 'common earthworm' is sufficiently clear without the parenthetical phrase, 'the angleworm of the New England disciples of Izaak Walton,' ten words of undisguised padding.

The statement on p. 356 regarding the Rhone would lead a student unfamiliar with the course of that river to suppose it was a subglacial stream, like the Yahtse in Alaska perhaps, whereas only its uppermost torrential portion occupies this relation to the ice. But the English of a scientific book is perhaps something aside from its real self. Happily there is less

to find fault with in regarding the book from this standpoint.

The chapter on Igneous Rocks is a handy compendium of recognized types. The classification makes mode of occurrence and age of secondary importance, and in this respect differs from while it gains in clearness upon the classification of Rosenbusch. While this portion of the book is rich in reference to rock types, it will hardly serve (as the author himself indicates by reference to special treatises) as a means of identifying igneous rocks.

The chemically formed rocks are described along with the clastic rocks under the heading of Aqueous Rocks. From the point of view of the genesis of these two groups of rocks it seems objectionable to classify them in this manner. Many of the chemically formed rocks are closely allied to the igneous rocks. Moreover, in geology, the term 'aqueous rocks' has been from the days of Lyell intimately associated with the fragmental rocks alone. The same extension of use for this term would embrace igneous rocks, in which the action of water is largely concerned.

It is to be noted that Griswold is misquoted in regard to the origin of the novaculites of Arkansas. Instead of supposing these rocks to be 'a chemical deposit in the form of a siliceous slime on a sea-bottom' (p. 111), this geologist, according to the very report quoted by Professor Merrill, makes the novaculites a deposit of very fine fragmental silica, almost without other materials laid down far from the shoreline in the form of mud or ooze. In the case of other quotations it is sometimes doubtful as to which author the work in a certain district is to be referred. One must look up these references, as, of course, the exhaustive student will take care to do.

The author introduces a few terms not before used in text-books. Colluvial, a name proposed by Professor Hilgard and here restricted to talus and cliff débris and avalanche material, appears to be inappropriate for deposits which owe their transportation to gravity rather than to running water. The time has undoubtedly come when this class of detritus should be given a distinctive name implying the mode of deposition, but the idea of water action, so clearly expressed in *colluvial*, is contradictory to the essential fact which distinguishes these deposits from alluvium. Regolith is a term proposed by the author for the superficial deposits or unconsolidated materials, the products of disintegration and decomposition. It is difficult to realize that this term has advantages over those it is designed to displace, since the superficial deposits of the earth form a very imperfect *blanket*, pierced by every outcrop of bed-rock and mountain peak, worn through along every rocky river bed and sea-cliff. We might take a hint from the quarryman's 'topping' and our 'epigene processes' to speak of the *epilith*, if we must have a Greek word for the 'waste' of the land.

Professor Merrill clearly points out the difference between metamorphism and weathering, and between atmospheric decay proper and those deep-seated changes which are sometimes included under this head.

Special importance is attached to the distinction between decomposition and disintegration in the case of the feldspars. Orthoclase may pass into the state of fine silt without actual decomposition. Such breaking up must be distinguished from decomposition, as it takes place in the lime-soda feldspars. Fournet is quoted as stating that hornblende yields less readily to decomposition than feldspar, while Becker holds the opposite as true. It may be noted here that in the Carboniferous arkoses of New England, derived from disintegrated hornblendic granitites, hornblende is invariably absent from the bleached basal sediments, the feldspar fragments having been evidently strong enough after the breaking down of the granitite to withstand transportation along with grains of quartz. It can hardly be said that the heavier but smaller hornblende grains would be altogether assorted out from the quartz and feldspar by mechanical means. The hornblende must have decomposed before the transportation of the particles.

The concretionary forms of joint-blocks in some igneous rocks and the huge granite bosses are thought by Professor Merrill to be alike an effect of weathering. Even the spheroidal structure of basalt, though admitted in deference to the opinion of some writers to be an original structure, is apparently in the author's

mind when accompanied by a weathering of the rock, to be regarded as a secondary effect.

All that Professor Merrill has to say regarding the processes and products of weathering is timely and important. From the difference in kind of weathering in cold and warm climates, a matter which has been studied by the geologists of India, it is pointed out that the study of the sedimentary rocks may be made to furnish a clue to past climates. It is to be regretted that there is not a chapter on the application of this principle to ancient rocks. The writings of Pumpelly, the work of Willis, Hayes, Campbell and others, together with the published evidence of ancient periods of base-levelling with peneplains and their complementary clastic records, constitute a basis for an interesting and valuable résumé.

As an extension to the treatment of the subject of rock-weathering in standard text-books on geology, this work can well be recommended to the student. For the student of agriculture and soil problems, it will probably give him as much of geology as he needs to know for practical purposes.

The book is well illustrated with diagrams and photographic reproductions. The mechanical execution of the book leaves nothing to be desired. There is a fairly complete index of authors cited and of subjects.

J. B. WOODWORTH.

HARVARD UNIVERSITY.

Bird Life; A Guide to the Study of Our Common Birds. By FRANK M. CHAPMAN. With seventy-five full-page plates and numerous text drawings by ERNEST SETON THOMPSON. New York, D. Appleton & Co. 1897. 12mo., cloth, pp. xii + 269. $1.75.

Confessedly addressed to the uninitiated rather than to the scientific ornithologist, this little volume nevertheless possesses an attraction for anyone interested in birds. The author apparently aims to present his subject in such a manner as to aid and incite further study and observation, the numerous footnote references in the first part of the book rendering the literature on the various subjects easily available. The whole is pleasantly written, and in language sufficiently untechnical to be easily comprehended. The first seventy-three pages treat of birds in general; the rest contain accounts of more than a hundred common Eastern species. The opening chapter briefly outlines the place of birds in nature, first with reference to their taxonomic position and phylogeny; then with reference to their relations to man, as profitable objects for scientific study, as valuable and efficient aids of the agriculturalist and as beings that appeal strongly to the æsthetic emotions. Under another caption are discussed the 'Factors of Evolution,' this being succeeded by an enumeration of the principal forms, variations and uses of the wing, the tail, the feet and the bill, illustrated by numerous text figures. In a chapter on the 'Colors of Birds' are detailed the changes and differences in colors due to age, season, molt, food, climate, haunts, habit and sex. Migration forms the subject of Chapter IV., and is discussed with regard to extent, manner and origin. This is followed by a short treatise on the 'Voice of Birds,' attention being called to both song and call notes. Under the next heading, 'The Nesting Season,' the value of observations during the breeding season is emphasized, and the time of nesting, mating, the details of nest and eggs and the care of the young, each in turn receive attention. Instructions on 'How to Identify Birds,' with suggestions upon points for observation, are also added, together with a field key to common land birds of the eastern United States, this taken, with additions and alterations, from the author's 'Handbook of Birds of Eastern North America.'

In the remaining portion of the book particular attention is devoted to some 125 species, these little biographies ranging from a few lines to nearly a page and a half, with usually a short account of the family to which each belongs. A number of other birds are incidentally noticed.

The 75 full-page plates with which the volume is adorned figure 99 species. In praise of their artistic finish, fidelity of form and minuteness of detail much might be said, and, though all are not of equal excellence, we are inclined to consider as not extravagant Mr. Chapman's claim that for beauty and accuracy these, as a whole, excel any black and white bird drawings that have ever been published in this country.

Furthermore, we think it not too much to say that the illustrations alone are more than worth the price of the book. Beneath each plate are added essential particulars of the size and colors of the species represented, this being evidently intended to supply, for purposes of identification, what is lacked by the pictures themselves.

In a work of such general excellence we are somewhat surprised to notice certain careless statements, as, for instance, that the number of shore birds known is 100, instead of more than 250; that the species of kingfishers are 108, instead of about 200; and that those of humming birds are 400, whereas above 500 really exist. These slips are, however, too few and of too little consequence to seriously detract from the value and usefulness of the volume. It is without doubt the best guide to the study of birds yet published, in this country at least, and should prove, as surely it will, indispensable to the beginner in ornithology. Furthermore, it can scarcely fail to increase the author's already enviable reputation for the felicitous combination of scientific accuracy with popular description.

Harry C. Oberholser.

Washington, D. C.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

The July number opens with a paper by A. de Forest Palmer, Jr., on the pressure coefficient of mercury resistance. The author calls attention to the discrepancy existing between the only determinations of the pressure coefficient previously published, namely, those of Barus, who obtained .00003 for the commercial mercury up to 400 atmospheres, and Lenz, who found .0002 for pure mercury between one and sixty atmospheres. In the experiments here described the mercury was carefully purified and distilled in a vacuum, and the pressures were obtained by means of the 'Screw compressor' of Barus, which is capable of indicating pressures up to something over 2,000 atmospheres. The Carey Foster method of measuring resistance was found most reliable. The results of the experiments are contained in two extended tables, and are further tabulated in a special chart. Taking β as the increment to unit resistance of one atmosphere increase in pressure, the equation obtained is as follows:

$$\beta = -.0000332 - 5 \times 10^{-9} t$$

where the last term, owing to its extreme smallness, is probably only approximately accurate. This result is very closely that of Barus, and the difference can be accounted for by the slight impurities in the commercial mercury used by him.

C. R. Eastman describes, with a series of figures, some remarkable Ctenacanthus spines from the Keokuk Limestone. Theo. Holm gives a fifth paper of his Studies in the Cyperaceæ, devoted to *Fuirena squarrosa* Michx. and *F. scirpoidea* Vahl. It is accompanied by two pages of illustrations. S. L. Penfield, of New Haven, and A. Frenzel, of Freiberg, Saxony, have a paper in which they show that the mineral chalcostibite (wolfsbergite) is identical with guejarite; they further give a detailed description of the form of the chalcostibite from Huanchaca, Bolivia.

H. W. Fairbanks has two papers, the first describing a striking case of contact metamorphism on Black Mountain, of the El Paso range, a spur of the Sierra Nevada Mountains, extending easterly into the Mojave desert. This is illustrated by a figure showing the diabase dike, with a slaty zone adjoining, of hard, firm rock, into which the soft tufa has been baked. The second paper describes the tin deposits at Temescal, southern California. The tin deposits here lie nearly in the center of a rudely semicircular area of granite about two miles in diameter and connected on the east with the great body of similar rock extending indefinitely in that direction. The sedimentary rocks along the edge of the granite area consist of quartzite, mica schist and conglomerate of unknown age. A part, at least, of the slates and limestones of the Santa Ana range are Carboniferous. The semicircular area of granite and portions of the adjoining porphyry have been fissured in a general northeast and southwest direction along almost innumerable lines, and a black vein matter deposited. The veins are generally small, varying from one-fourth to a few inches in thickness, but in the case of the main tin-bearing vein an enormous size is reached at Cajalco

Hill. As the hill is approached the veins become larger and finally culminate in this elevation, which is about 300 by 250 feet in diameter at the base. The veinstone of which it is mostly composed rises in prominent and bold croppings. With one or two unimportant exceptions, the material of which this, as well as the other veins, is formed consists wholly of tourmaline and quartz, with which the tin ores are locally associated. The larger veins, and the Cajalco in particular, are very irregular in size, sometimes appearing to be mere bunches in the granite. A few hundred feet northeast of the hill the vein has narrowed to six or eight feet, and it is here that the large body of tin was first discovered and the main shafts sunk. A slide prepared from one of the smaller veins, which in the hand specimen appeared to consist wholly of tourmaline, showed bunches of tourmaline crystals radially arranged and imbedded in interlocking quartz grains.

T. Wayland Vaughan has a paper on the outlying areas of the Comanche Series in Oklahoma and Kansas, in which he describes numerous localities in the region indicated, and supports Mr. Hill's conclusion in regard to the Cretaceous age of the deposits. He concludes that the supposed 'Jurassic' of Marcou "has been proven not only not Jurassic, but that it belongs to Cretaceous beds above his so-called *Neocomian*, which is far above the base of the American Cretaceous."

W. G. Mixter has an extended article on electrosynthesis, or chemical union, affected by means of electricity, but not, as distinguished here, that brought about by the heat of the electrical discharge. The special apparatus employed is described, and the eudiometric observations made with a mixture of hydrogen and oxygen, of carbonic oxide and oxygen, methane and oxygen, ethylene and oxygen, acetylene and oxygen. A comparison is made in several cases between the number of molecules oxidized and those of oxygen consumed, and it is concluded that the same electrical current causes the oxidation of a different number of molecules of the gases, the variation being as one to two, while the oxygen consumed varies as one to seven molecules. In conclusion the author regards the molecular change involved in electrosynthesis "to be analogous to those occurring in synthesis effected by heat or light where combination takes place at a temperature far below that at which the gaseous molecules dissociate." W. Lindgren describes monazite from the gold-bearing gravels near Idaho City, in Idaho, where its occurrence is analogous to that observed at other points, as in the eastern United States, Brazil, the Ural Mountains, etc. It doubtless forms an original constituent of the granite of the Idaho basin.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES.

THE last meeting of the Academy until October took place in the lecture room of the Department of Physics, Columbia University, June 7th. Professor William Hallock described 'A New Method for Projecting Views of the Moon.' A hemisphere about 6 or 8 feet in diameter had been prepared and had been whitened. Using this for a screen, Dr. Hallock projected upon it views of the moon with a powerful arc-light lantern, adjusting the distances so that they just fitted the spherical surface. The natural features of the moon were reproduced with extraordinary vividness and lost all the flattening that is unavoidable with plane surfaces. The only drawback is the lack of sharp focus on the edges of lunar photographs. Adopting a suggestion of Professor Rood, Dr. Hallock had gone off at one side of his spherical screen, while a view of the moon was projected upon it, and had photographed it, thus securing a view of half the lunar surface, as if it had been taken at a point in space at right angles to the line connecting the moon and the earth. It gave a fairly true picture of one quarter of the moon from this point of view. Professor Rood had also suggested the value of projecting photographs of diversified topography of the earth on suitably inclined screens, with the object of reproducing their true relations in space, so as to aid topographic mapping. Such projections when viewed from above would give a bird's-eye view of a landscape in its true relations. Dr. Hallock will communicate a full account of these devices to an early issue of SCIENCE.

Miss F. R. M. Hitchcock next presented a

paper on the atomic weight of tungsten, which will appear in the Transactions of the Academy. The tungstic trioxide was prepared from sodium tungstate and gave no traces of silica, niobic or tantalic oxides, iron or manganese, the alkalies or alkaline earths, or molybdenum. The acid was transformed to ammonium salts. By fractionating these, the following atomic weights were obtained, quantities of from 1.5 to 5 grams being used. The different series had been subjected to a different, previous preparation.

	Series A.	Series B.
1st Fraction	182.34	182.34
2d "	182.77	174.63
3d "	179.92	181.87
4th "	183.45	181.79
4a "		174.87
5th "		177.87
5a "		176.79

Another portion of the trioxide, fractionated by a different method, gave on successive reductions and oxidations of the same portion the following series, in which it will be noted that the weights increase with the oxidations and diminish with the reductions:

	Reduction.	Oxidation.
At. W't.	182.68	184.65
	177.25	185.26
	174.00	191.61

The results of fifty determinations gave atomic weights ranging between 154.064 and 191.61. A series of experiments, that were only briefly referred to, established the fact that in all preparations of WO_3 nitrogen was present, even after repeated reduction. Miss Hitchcock was led to conclude that as regards volatility, metallic tungsten is more volatile than the oxide. Wolframite was found to contain both hydrogen and nitrogen, and scheelite has large quantities of nitrogen.

J. F. Kemp,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, MEETING MAY 19.—ABSTRACTS OF PAPERS PRESENTED.—ORIGIN OF THE PRONEPHRIC DUCT IN SELACHIANS.

There have been different opinions as to the origin of the Pronephric Duct in Selachians. Acanthias embryos were used in making a renewed study of the subject. The Anlage of the Pronephros consists of segmental outgrowths of the somatic layer of the somites from the seventh to the twelfth segments. These are connected with the ectoderm at their outer edge. This fusion early disappears. The tip of the distally growing duct was constantly fused with the ectoderm. One case of Karyokinesis between ectoderm and duct was found. Growth also takes place throughout the length of the duct. Frontal sections showed six Pronephric tubules on the right side with aortic diverticula between. Connected with the aorta there were also found structures which may be interpreted as glomi.

From the facts here given we conclude that the earliest Anlage of the Pronephros fuses temporarily with the ectoderm and may possibly receive some few cells from it. The first part of the duct proper seems to share to some slight degree in the mesodermal origin of the anterior region. So far as the duct develops distally the connection of its tip with the ectoderm is maintained. This fusion would be sufficient evidence of a genetic relation for those who accept the principle of the teloblastic growth of organs. On the appearance of the paper by Rabl the preparations were again examined carefully, but without finding any grounds for abandoning the view that there is a genetic connection between the duct and the ectoderm in Selachians.

Emily Ray Gregory.

Dr. Whitman followed with a paper on 'The Development of the Wing-bars in Pigeons.'

NEW BOOKS.

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